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HYDROCARBON FUEL HANDLING AND CONTAMINATION CONTROL

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Robert D. Brown
Charles M. Monita

Southwest Research Institute

TECHNICAL REPORT AFAPL-TR-69-30

April 1969

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FOREWORD

This report was prepared by Southwest Research Institute, San Antonio, Texas, under Contract F33615-68-C-1216. The contract was initiated under Project Nos. 8174 and 3048, Task Nos. 817411 and 304805. The work was performed by contractor's personnel using Air Force facilities at Wright-Patterson AFB. The program was administered by the Fuels, Lubrication, and Hazards Branch, Support Technology Division, Air Force Aero Propulsion Laboratory, Air Force Systems Command, Wright-Patterson AFB, Ohio. The Air Force project engineer was Mr. Paul C. Linder (APFL).

This is the final report under this contract; it covers work performed between 1 December 1967 and 1 December 1968 under subject contract. This report was submitted by the authors on 1 February 1969. Contractor's identifying numbers are Project No. 09-2277 and Report No. RS-531.

This technical report has been reviewed and is approved.

Arthur V Churchill

Arthur V. Churchill, Chief
Fuels Branch
Fuels, Lubrication and Hazards Division
Air Force Aero Propulsion Laboratory

ABSTRACT

Procedures have been developed for comparing jet fuel/inhibitor combinations in a specially designed single-element filter-separator test loop. A short-term procedure has been developed in which the schedule of contamination with solids and water is analogous to what may be encountered under field conditions. Only broad-scale classification of fuel corrosion inhibitors is possible when using either this procedure or more conventional filter-separator test procedures. Attempts to develop more severe and more discriminating procedures led to poor repeatability of results. Performance in the single-element tests could not be related to separometer (WSIM) results, and several extreme examples of noncorrelation were noted both for corrosion inhibitors and fuel-soluble surfactants. Other studies in this program included the development of a small-scale coalescence rig, investigation of separometer test variability, and miscellaneous studies in the general field of fuel handling and contaminant control.

Distribution of this abstract is unlimited.

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SECTION I

INTRODUCTION

This is the final report on a one-year segment of a continuing program in research and development in hydrocarbon fuel handling and contaminant control. Portions of this work have been covered in reports on specific topics, and these reports are referenced herein where applicable.

This work has been concerned largely with the development of suitable test procedures for evaluating filter-separator elements, fuels, and fuel additives. During the period reported here, emphasis has been placed on the development of a single-element test procedure for rating the effects of fuel corrosion inhibitors on element performance.

Another phase of this work has been concerned with the development of a small-scale device for studying various filter media and the interrelations between filter medium, fuel properties, and flow conditions.

Numerous other investigations have been undertaken during the course of this program. Most of these have been very limited studies of short-range problems connected with specific equipment or procedures in fuel handling. Some of these investigations are reported here, in cases where the implications of the work go beyond the immediate problem.

Complete data from the single-element program are included in this report, along with discussion of some of the more important observations and conclusions. Full analysis of these data is in process and will be covered in future reports.

SECTION II

TEST FACILITY AND EQUIPMENT

1. TEST LOOP

The test loop used in the experiments described herein has been described in detail in a previous report*. This loop was designed for testing single elements or filter-separator assemblies at flow rates from 15 to 60 gpm under carefully controlled conditions. The primary materials of construction were aluminum and stainless steel; no copper alloys or carbon steels were used for fuel-wetted parts. For purposes of identification in this report, this facility is termed the "Al/SS loop."

A simplified flow diagram of this loop is shown in Figure 1. For the work reported herein, fuel was brought into one of the two tanks shown in the diagram and recirculated through the test system and back to the same tank. Each load of fuel for a given test was 600 gal, and the flow rate for most tests was 20 gpm. Thus, the "turnover time" for a complete cycle of the fuel supply was 30 min.

The water injection system is independent of the water-main pressure and can be used either with filtered water from the mains or with blended water of any desired composition. Water is injected into the main fuel stream and dispersed by means of a mixing screen. Ahead of the water injection point, dry fuel is drawn to feed the solids injection system, which is shown schematically in Figure 2. Dry-dirt injection was used in most of the work reported herein, but premixed slurry was used in a few tests.

Essentially all of the work reported herein was performed with an 8-in. aluminum housing equipped with a single military-standard element and a double-wall, PTFE-coated screen canister. Brief studies were made with a transparent housing designed for observation of flow patterns. Both of these test housings are described in detail in the report referenced previously.

The clay filter shown in Figure 1 was installed during the latter part of the program. It is a Peco Series 34, Model 34-3-736D, rated at 42 gpm, with clay-canister elements.

* Johnston, R. K., Monita, C. M., Brown, R. D., and Valtierra, M. L. (Southwest Research Inst.), "Design of a Filter-Separator Test Facility for Research on Fuels and Equipment," AF Aero Propulsion Lab. Rept. AFAPL-TR-68-69, June 1968.

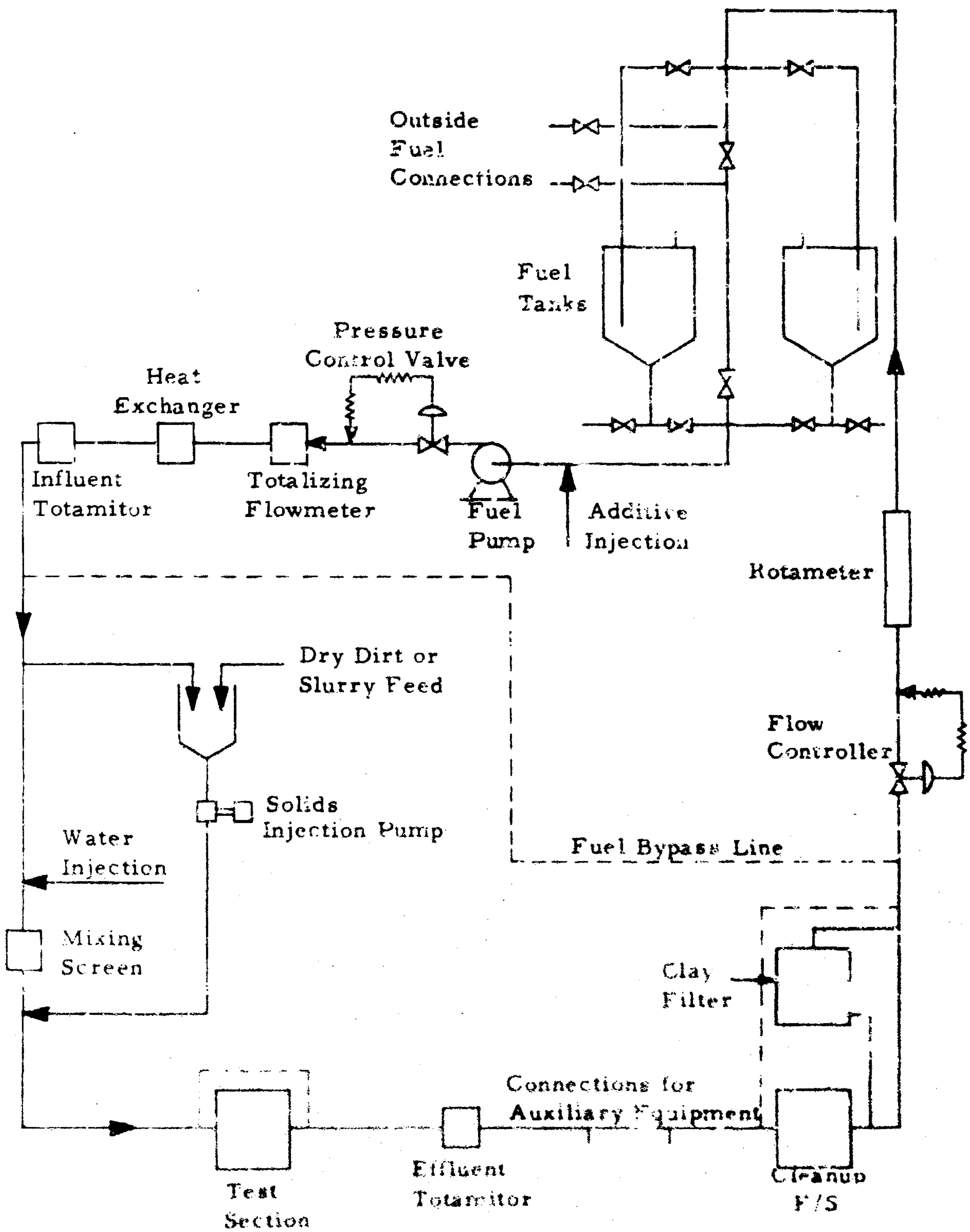

FIGURE 1. SIMPLIFIED FLOW DIAGRAM OF AI/SS LOOP

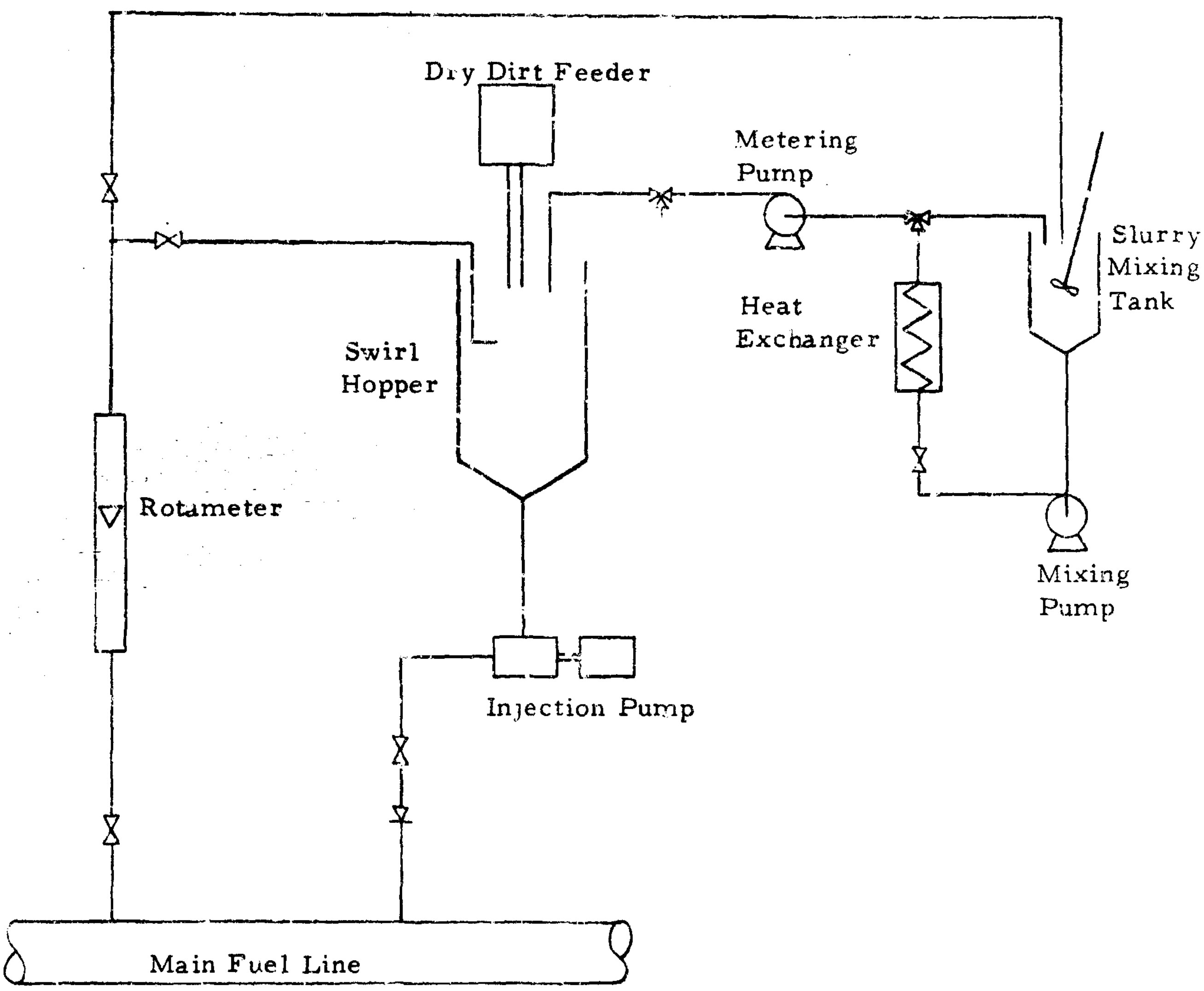

FIGURE 2. SOLID-CONTAMINANT SYSTEM

2. SMALL-SCALE EQUIPMENT

Bench-scale and laboratory equipment used in this program is described in later sections of this report, along with the discussions of results obtained with such equipment.

SECTION III

TEST MATERIALS

TEST FUEL

Test fuels for this work were JP-4 and JP-5, supplied without icing inhibitor or corrosion inhibitor. These fuels were held in Air Force storage facilities for this program and other programs. Fuel was transferred from Air Force storage by means of refueling trucks in batches of 12-25,000 gal to storage tanks located adjacent to the test facility. Each such transfer represented a "batch" of fuel as defined for this program:

Batch no.	Type	Used in loop tests, nos.:
14	JP-4	48-62
15	JP-5	63-76
16	"	77-83
17	"	84-99
18	"	100-128
19	"	129-150
20	"	151-175
21	"	176-199
22	"	200-211
*	JP-4	212-219
23	JP-5	220-234

* From Area B, Tk 12, recd 6 Feb 67

Inspection data for these fuels are presented in Table 1.

2. FUEL ADDITIVES

Fuel corrosion inhibitors used in this work are listed below, along with the abbreviated designations used in tables of this report:

TABLE 1. INSPECTION TEST RESULTS ON UNINHIBITED FUELS

Grade:	JP-4[a]	JP-4	JP-5[b]	JP-5
Source:	Ashland	Specs	Ashland	Specs
Date or spec number:	1/25/67	5624G	10/6/67	5624G
Source Inspections:				
Gravity, API/60	55.2	45-57	42.0	36-48
Distillation: IBP, °F	126	---	380	---
10%, °F	192	---	398	---
20%, °F	224	290 Max	402	---
50%, °F	300	370 Max	412	---
90%, °F	420	470 Max	446	---
EP, °F	506	---	490	550 Max
Residue, %	0.5	1.5 Max	1.0	1.5 Max
Loss, %	0.5	1.5 Max	1.0	1.5 Max
Existent gum, mg/100 ml	0.6	7 Max	0.6	7 Max
Potential residue, mg/100 ml	1.8	14 Max	2.9	14 Max
Sulfur, %	0.122	0.4 Max	0.04	0.4 Max
Mercaptan sulfur, %	0.0005	0.001 Max	0.0006	0.001 Max
Reid vapor pressure, psi	3.0	2.0-3.0	---	---
Flash point, °F	---	---	154	140 Min
Freezing point, °F	-83	-76 Max	-63	-51 Max
Aniline point, °F	140.5	---	145.5	---
Aniline-gravity product	7756	5250 Min	6111	4500 Min
Heat of combustion, btu/lb	---	---	18581	18300 Min
Smoke point, mm	30.6	---	22	19 Min
Smoke-volatility index	67.4	52.0 Min	---	---
Copper strip corrosion	1-A	1 Max	1-A	1 Max
WSIM	96	N.A.[c]	98	70 Min
Water reaction (interface)	1	1-b Max	---	---
Thermal stability:				
Filter ΔP, in. Hg	0.0	3.0 Max	0.0	3.0 Max
Preheater rating	1	< 3	1	< 3
Particulate matter, mg/gal	2.4	---	---	---

a. Source inspections on fuel corresponding to SwRI Batch 14.
b. Source inspections on fuel corresponding to SwRI Batches 21-23.
c. Spec not applicable to uninhibited fuel.

TABLE 1. INSPECTION TEST RESULTS ON UNINHIBITED FUELS (Cont'd)

SwRI Batch No.	Sample from	Date	API Grav.	Distillation, °F IBP-10%-20%-50%-90%-EP	Gum, mg/100 ml Exist.	Gum, mg/100 ml Pot.	Flash, °F	RVP, psi	WSIM
	JP-4 Fuel								
--	Ashland[a]	1/25/67	55.2	126-192-224-300-420-506	0.6	1.8	---	3.0	96
14	Tank	3/16/67	---	122-188-220-299-423-499	0.4	---	---	2.9	---
	JP-5 Fuel								
15	Truck	4/10/67	---	353-380-394-421-468-496	0.2	0.2	---	---	---
15	Tank 1	4/21/67	42.7	340-377-389-415-460-494	0.6	0.6	134	---	99
15	Tank 2	4/21/67	42.7	346-378-389-416-458-488	0.6	0.6	137	---	---
15	Tank 2	5/31/67	---	353-382-395-422-465-490	1.0	1.0	135	---	88
16	Tank 1	5/31/67	---	356-380-396-421-462-491	1.0	1.0	134	---	---
16	Tank 2	5/31/67	---	354-383-396-423-464-490	1.0	1.0	136	---	89
17	Tank 1	7/6/67	42.7	348-383-394-420-462-491	0.4	0.6	134	---	72
17	Tank 2	7/6/67	42.7	351-382-396-422-466-489	0.4	0.8	134	---	87
18	Tank 1	8/14/67	42.5	353-382-394-421-465-494	1.2	1.4	136	---	---
18	Tank 2	8/14/67	42.5	358-378-397-421-466-498	1.4	1.4	138	---	---
19	Tank 1		No data except WSIM						94
20	Tank 1	10/5/67	42.6	357-385-395-420-467-500	0.2	0.8	137	---	95
20	Tank 2	10/5/67	42.6	357-384-395-422-468-499	0.6	1.2	138	---	77
--	Ashland[a]	10/6/67	42.0	380-398-402-412-446-490	0.6	2.9	154	---	98
21	Tank 1	1/16/68	41.1	372-399-----425-456-484	1.0	1.0	146	---	98
21	Tank 2	1/16/68	41.1	372-398-----424-454-494	0.8	1.0	147	---	94
22	Tank 1	3/18/68	41.2	366-396-405-422-453-491	0.2	---	148	---	89
22	Tank 2	3/18/68	41.1	380-401-408-426-457-498	0.4	---	148	---	---
23	Tank 1	6/28/68	41.8	362-386-394-415-458-482	0.0	1.0	143	---	92
23	Tank 2	6/28/68	41.7	364-384-390-412-456-490	0.0	1.0	144	---	95
23	Tank 1	7/22/68	41.8	356-382-390-412-457-481	1.0	1.0	143	---	87
23	Tank 1	8/16/68	41.9	346-384-394-414-457-482	---	---	---	---	78
23	Tank 2	11/18/68	41.8	369-388-395-415-458-495	0.0	0.6	145	---	75
23	Tank 2	12/3/68	41.7	372-388-395-417-458-493	0.2	0.6	144		

a. Source inspections by Ashland. All other inspections by AF Aero Propulsion Laboratory.

Snt	Santolene C (Monsanto)
AFA	AFA-1 (duPont)
RP	Rust Preventive-2 (duPont)
Uni	Unicor M (Universal Oil Products)
EDS	Na-Sul EDS (Vanderbilt)
Tol	Tolad 244 (Petrolite)

All of these inhibitors except the Na-Sul EDS are qualified materials under MIL-I-25017C. The Na-Sul EDS had been qualified under an earlier version of the inhibitor specification, before any close restrictions had been placed on emulsification behavior.

The icing inhibitor used in this work, designated as AIA (anti-icing additive) or FSII (fuel system icing inhibitor), was obtained from Dow Chemical Company and conformed to MIL-I-27686D. The specified composition of this material is 99.6% 2-methoxyethanol (ethylene glycol monomethyl ether) and 0.4% glycerin.

Five other additives used in this group of tests were as follows:

ASA	Antistatic additive ASA-3 (Shell)
PtL	Petronate L sodium sulfonate (Witco)
PtCR	Petronate CR sodium sulfonate (Witco)
NC-2	Sodium naphthenate from 415 mol. wt. acids, 25% active ingredient
NA-1	Sodium naphthenate from 310 mol. wt. acids, 25% active ingredient.

3. INJECTION WATERS

The contaminant-water used in these tests consisted either of filtered tap water or synthetic blends of various compositions. The tap water available from the mains at Wright-Patterson AFB is hard well-water with no treatment except chlorination to 0.4 ppm gas injection. Total hardness is about 380 ppm, and pH is about 7.6. It has been used for a considerable amount of single-element testing and has been found to be quite consistent in pH and surface tension. It appears quite suitable for use in filter-separator testing, so long as a suitable filter is installed in the water injection system to guarantee a low content of insoluble material.

The principal synthetic water composition used in this work was designated "Type B," since it is a close match for the Type B medium-hardness water frequently cited in handbooks as typical of Great Lakes water supplies. The Type B synthetic water was blended from distilled

water and reagent-grade chemicals to the following composition (mg/liter):

Actual ingredients blended	
$NaHCO_3$	164
$CaCl_2 \cdot 2H_2O$	132
$MgSO_4 \cdot 7H_2O$	82

Ionic concentrations	
Ca	36
Mg	8.1
Na	45
Cl	64
SO_4	32
HCO_3	119

Other synthetic waters were blended for special tests, using distilled water or Type B blend as the base for investigating the effects of water composition and properties on element performance.

4. SOLID CONTAMINANTS

The four solid contaminants used in this work were standard coarse AC dust, standard fine AC dust, standard fine red iron oxide (I-116), and another red iron oxide (R-9998). The first three of these materials are used regularly in filter-separator testing and are defined in filter-separator specifications. The R-9998 red iron oxide was used experimentally in one test in this program.

The AC dusts are siliceous "Arizona road dust" that has been collected and standardized for use in testing air cleaners and filters. The coarse grade has a broad range of particle size, with appreciable amounts in the 80-200 and below 5 μ fractions. The fine grade is prepared from the coarse by removing the larger particles.

Both of the red iron oxides are high-purity materials produced by calcination of ferrous sulfate. These materials are much finer in particle size than the AC dusts; the Fisher I-116 is considerably the finer of the two red iron oxides.

Complete specifications on particle size distribution of these materials are given in Table 2.

TABLE 2. PARTICLE SIZE DISTRIBUTION OF TEST DUSTS

	Standard AC test dust		Red iron oxide	
	Coarse	Fine	Pfizer R-9998	Fisher I-116[a]
Weight % below 200μ	100			
80	91	100		
40	61	91		
20	38	73		
15			100	100
10	24	57	99.3	100
7.5			98.3	99.7
5	12	39	84.9	98.9
4			74.5	98.2
3	8[b]	21[b]	25.2	97.9
2	5[b]	11[b]	7.3	97.1
1			5.6	94.1
0.5			4.9	77.7
0.25				47.8

a. Same as Pfizer R-2199.
b. Not specifications; values based on analysis of a few samples.

5. FILTER-SEPARATOR ELEMENTS

All of the filter-separator elements used in the tests reported herein were Filters Inc. I-4208 elements, which are of the military-standard design specified in MIL-F-52308.

SECTION IV

TEST PROCEDURES

1. LOOP TEST PROCEDURES

a. General

The test procedures discussed in this section are those used in single-element loop tests reported herein. Test procedures for other apparatus are discussed elsewhere in this report.

A total of 21 test procedures were used in the single-element loop tests reported herein. Most of these procedures are directed toward the evaluation of inhibited fuels and are similar in concept to the inhibited-fuel test of MIL-F-8901A. The test procedures are outlined in the following pages and are listed for convenient reference in Table 3, which also shows the loop test numbers corresponding to each procedure number.

The bulk of the work was performed using procedures 10, 13-A, and 13-J. Procedure 10 is the same as the MIL-F-8901A inhibited-fuel test as to solid contaminant (coarse AC dust) and test schedule (60 min water injection only, then water and solids to 40 psi). Type B synthetic water was specified for Procedure 10, but some of the later tests were run with filtered tap water, after it had been found that the effects of water composition were of little significance. The sampling schedule and other details of Procedure 10 differ from those of the MIL-F-8901A inhibited-fuel test, as will be seen from the detailed outline to be presented.

Procedure 13-A represents a revision of Procedure 10 toward the direction of a more realistic sequence of operations. The solid contaminant is coarse AC dust (as before); the injection water is filtered tap water. The schedule requires injection of dust along with a very small amount of water (0.01% of fuel flow) until the element pressure drop reaches 20 psi. At this point, the dust injection is discontinued and the water injection rate is increased to 1% of fuel flow rate for a 15-min period. At this time, if the element pressure drop has not risen to 40 psi, water injection is continued at 1% and dust injection is restarted and continued to 40 psi pressure drop. This procedure is designed to eliminate the excessive water washing of the fuel and element that exists in MIL-F-8901A and Procedure 10 during the initial 1-hr period.

Procedure 13-J is identical to 13-A except for the use of fine AC dust as the solid contaminant.

TABLE 3. PROCEDURES USED IN LOOP TESTS

Procedure no.	Loop test nos.	Type of procedure
10	48-83, 91-100, 110, 134, 138, 142, 143, 148	Similar to MIL-F-8901A inhibited-fuel test
11	84-86	MIL-F-8901A inhibited-fuel test
12	87-90	MIL-F-8901 red iron oxide slurry test
13-A[a]	101 (107) 109, 125, 132, 133, 136, 137, 140, 141, 144, 184-224, 230-242	"Dirt-first" loading with coarse AC dust and 0.01% water before 1% water injection
13-B	102	Initial dust without water
13-C	103	Final water rate 3%
13-D	104	Extra 8 hr of fuel flow
13-E	105	Red iron oxide (I-116)
13-F	106	Dust injection rate 25% normal
13-G	111	Fuel and water rates increased
13-H	112	Water into fuel pump suction
13-I	113, 114	Fuel 16 gpm; water to pump suction
13-J	115, 126, 127-131, 135, 139, 145, 149-151, 154, 155, 157, 159, 161, 162, 170, 172, 176-179, 225-229	Fine AC dust
13-K	116	Fine AC dust; water 1% throughout
13-L	117	Same, extra 120 min fuel and water
13-M	124	Red iron oxide (R-9998)
13-N	152, 153, 156, 158, 160, 163-165, 171, 173	Fine AC dust at 50% normal rate
13-O	166-169, 174, 175, 180-183	50/50 fine and coarse AC dust
14	108	4-hr cycles
14-A	118, 119, 121-123	4-hr cycles, fine AC dust
14-B	120	4-hr cycles, fine AC dust, loaded to 10 psi only

a. Procedure 13-A and all subsequent procedures are of the "dirt-first" type in which the element is first loaded to 20 psi (or some specified pressure drop) with test dust, accompanied by 0.01% water. This is followed by a period of 1% water injection without dust injection, then by dust and water (1%) until the pressure drop reaches 40 psi. Subsequent procedures differ from 13-A only as specified.

Procedures 11 and 12 are MIL-F-8901A procedures, slightly modified, for a special series of evaluation tests.

All of the other procedures represent modifications of 13-A or 13-J that were investigated during the course of procedure development.

b. Procedure 10

Tests are run with a single military-standard coalescer element and double-wall canister mounted in an 8-in. aluminum housing. A fresh element is used for each test. The canister and housing are cleaned and rinsed thoroughly between tests.

Standard test conditions are:

Fuel flow rate	20 gpm
Fuel supply pressure	70 psi
Fuel temperature entering test section	80°F (75°F in early tests)

Standard contaminants are coarse AC dust and Type B synthetic water. The test schedule starts with a 15-min "pre-test" period with fuel flow but no contaminant injection. The start of the test proper (zero time) is the end of this pre-test period, at which time the contaminants are injected according to the following schedule:

0-60 min	Water 0.2 gpm, no solids
Remainder (to 40 psi)	Water 0.2 gpm, solids 5.72 g/min

The solids injection rate corresponds to a concentration of 0.286 g/gal in the fuel. At this injection rate, the element is loaded to its nominal dirt-holding capacity of 200 g in 35 min.

Either fresh base fuel or fuel from the preceding test may be used. The following step-by-step test procedure is used with fresh base fuel, starting with a clean system:

Weigh a new coalescer element to the nearest gram, and check for integrity in the coalescence tank, using uninhibited base fuel. Then, install the element in the single-element aluminum housing, along with a double-wall canister.

Note: The element may be installed at any time prior to the start of the pre-test period.

Pump 600 ± 50 gal of clean base fuel through a suitable cleanup filter-separator (outside the loop) and into one of the loop fuel tanks. Determine the amount actually charged by meter readings, tank gage glass level, and line and component holdup volumes established previously. All subsequent operations are performed using this one tank with recirculating fuel.

Circulate at 40 gpm through the cleanup filter-separator (bypassing the test housing) until the fuel is clean and dry as determined by Totamitor readings and sample analyses as required. The fuel temperature should be adjusted to approximately 80°F during this time.

Circulate at 40 gpm through the main fuel bypass (bypassing both the test housing and the cleanup filter-separator). Inject the required amount of corrosion inhibitor over a 15-min period, then inject the required amount of fuel system icing inhibitor over a 15-min period and flush the injection system and lines with test fuel. Direct the main fuel flow through the cleanup filter-separator (but bypass the test housing), and continue to recirculate for a minimum of 15 min at 40 gpm. Recheck the cleanliness of the fuel.

> Note: The preceding step is omitted when additive-free fuel is being tested.

Inspect and clean the mixing screen, or install the screen if it has been omitted from the screen housing during the preceding operations.

Set the fuel flow rate at 20 gpm, set totalizing flowmeter reading at zero, and direct the fuel flow through the test housing and cleanup filter-separator. Recirculate for 15 min. During this "pre-test" period, adjust flow rates and temperatures, check operation of all instruments, take samples as required, and have the water injection system running and ready to direct the flow into the fuel line.

At the end of the 15-min pre-test period, start timing the run and direct the water flow into the fuel line. Take readings and draw samples as indicated in subsequent paragraphs. When the water level in the test housing covers the openings in the canister base, drain water at a rate that will maintain a stable level in the housing.

During the 60-min test period with water injection, prepare the solids injection system for operation and calibrate the dirt feeder, if this has not been done previously. Five min

before the end of this 60-min period, direct fuel flow at 3 gpm into the swirl hopper, and turn on the solids injection pump; regulate the pump speed to maintain a stable fuel level in the swirl hopper.

After 60 min of test time, start the dirt feeder. Continue to inject both solids and water until the pressure drop across the test housing reaches 40 psi. At that time, cut off the water injection and dry-dirt feed, take final samples, and shut down the fuel flow.

Record test housing pressure drop and Totamitor readings every 10 min throughout the run, and also (a) 35 min after the start of solids injection, i.e., after 95 min of test time, (b) when the pressure drop reaches 20 psi, and (c) when the pressure drop reaches 40 psi. Totamitor readings are taken from the recorder charts after the run, and any peaks occurring between the regular readings should be noted. Record screen pressure drops, cleanup filter-separator pressure drops, and totalizing flowmeter readings approximately every 30 min of test.

Draw samples for analysis as follows:

Clean influent fuel - solids	Pre-test, 30 and 95 min
Same - WSIM, IFT, and FSII content	Pre-test and 95 min
Effluent fuel - solids and free water	30, 95, and 130 min, and 20 and 40 psi
Injection water - solids	30 min
Same - pH and surface tension	30 and 95 min
Coalesced water - pH, surface tension and FSII content	30 and 95 min

Remove the coalescer element from the housing without losing any test dust, rinse in isopropanol and then petroleum ether, dry to constant weight, and record the weight to the nearest gram.

If the same fuel is to be reused in the subsequent test, analyze for FSII and reblend to the required level, then continue with the next test.

If the next test requires fresh fuel, pump the used fuel to scrap storage and drain the loop system thoroughly.

Bring in base fuel (same as used for the next test) and circulate through the cleanup filter-separator at 40 gpm for 30 min; then, discard this fuel and drain the loop thoroughly. Repeat with a fresh batch of uninhibited fuel, but this time bypassing the cleanup filter-separator. During this time, replace the cleanup filter-separator elements with fresh elements. Discard and drain the second flush. Then, bring in fresh uninhibited fuel and start the new test sequence as described previously*.

b. Procedure 11

This is essentially the MIL-F-8901A inhibited-fuel test procedure as adapted for the Al/SS loop. The test fuel is JP-5 containing 16 lb/Mbbl of Santolene C; freshly blended fuel is prepared for each test. The sampling schedule follows that of 8901A except for the addition of samples for AEL determination of free water content and certain special samples for modified Karl Fischer determinations of total water content. The following sample schedule was used:

Effluent-fuel solids	65, 70, 80, 95, 110, 120, 130 minutes; 20, 30, 40 psi
Effluent-fuel K-F	5, 10, 20, 30, 40, 50, 60, 70, 80, 95 110, 120, 130 minutes; 20, 30, 40 psi
Clean-fuel K-F	30, 60, 95, 130 minutes; 20, 30, 40 psi
Clean-fuel saturation	Pre-test
Effluent-fuel AEL, line (2) and bottled (2)	95 minutes, 20, 30, 40 psi
Clean-fuel WSIM	Pre-test
Clean-fuel IFT	Pre-test; 40 psi
Injection-water solids, pH, surface tension	50 minutes

In actual operation, it was found that the 20-30-40 psi samples along with the 80 and 95-minutes samples came so close together that it was impossible to get them all. Also, it was found that in all tests, the pressure drop reached 40 psi in 95 minutes or less, so that there were no subsequent samples.

*Cleanup filter-separator elements need not be replaced if the next run is to be made on a new fuel blend of the same composition.

c. Procedure 12

This is essentially the MIL-F-8901A red iron oxide emulsion test, commonly termed the "slurry test." Briefly, the test procedure consists of injecting 3% water and 0.0035 lb of slurry per gallon of fuel until the pressure drop reaches 40 psi. The slurry consists of 0.1 lb of I-116 red iron oxide per pound of 50-50 water-fuel mixture, thus containing 9.09% of oxide by weight. The solids injection rate is 0.145 g per gallon of fuel, or 2.89 g/min in a 20-gpm test. At this rate, the nominal dirt-holding capacity of 200 g is reached in approximately 70 min of injection.

In the tests reported here, the test fuel was uninhibited JP-5, instead of the VV-K-220 kerosine specified in MIL-F-8901A. As in Procedure 11, certain additions were made to the sampling schedule, resulting in the following:

Effluent-fuel solids	5, 10, 20, 30, 40, 50, 60, 70 minutes; 10, 20, 30, 40 psi
Effluent-fuel K-F	Same as above
Clean-fuel K-F	10, 20, 30, 40 psi
Clean-fuel saturation	Pre-test
Effluent-fuel AEL, line (2) and bottled (2)	10, 20, 30, 40 psi
Injection-water solids, pH, surface tension	50 minutes

It was found that there was some "pile-up" in sample scheduling, and slight modifications had to be made to fit the behavior of the individual tests.

The method of preparing and injecting the slurry is somewhat different than that described in MIL-F-8901A. Slurry of standard composition is prepared prior to test in a slurry mixing tank with recirculating pump (see Figure 2). This system had been designed to handle thin slurries, and the pump capacity and line sizes are inadequate to do a thorough mixing job on thick slurry. Therefore, the pump is used only to keep the bottom of the mixing tank clear by recirculating, with no back pressure other than pressure drop in the lines. The actual mixing of the slurry is performed with a mechanical stirrer (propeller type), which is run continuously while preparing and injecting the slurry.

Slurry from the recirculating line is picked up by means of a peristaltic pump and metered into the injection hopper, where it is picked up by the fuel stream and solids injection pump, i. e., handled just as if it had been dry dirt. Metering of the slurry is reasonably accurate, but there are problems with deposition of red iron oxide in the slurry mixing tank and deposition of slurry in the injection hopper. When slurry is metered into the swirling fuel stream in the hopper, it becomes very evident that the feed rate into the main fuel line is erratic because of temporary hang-up of slurry globules, and also that the slurry is very resistant to dispersal in fuel. In order to avoid the temporary and sometimes permanent hang-up of slurry globules in the injection hopper, the slurry feed line is directed to the center of the hopper, i. e., where the slurry will drop directly into the inlet of the Moyno injection pump.

d. Procedure 13-A

This procedure is similar to Procedure 10 except for major changes in the schedule of water and solids injection, which in turn affect the sampling schedule. The only other significant change (in comparison with Procedure 10) is the use of filtered tap water rather than synthetic water. The solid contaminant is coarse AC dust (same as Procedure 10). The fuel flow rate is 20 gpm, the fuel supply pressure is 70 psi, and the fuel temperature entering the test section is 80°F. The following test schedule is used:

0 min to 20 psi	Water 0.002 gpm, solids 5.72 g/min
Next 15 min:	Water 0.2 gpm, no solids
Remainder (to 40 psi):	Water 0.2 gpm, solids 5.72 g/min

The corresponding ratios of contaminants to fuel are: water 0.01 and 1% of fuel flow, and solids 0.286 g/gal. At this solids injection rate, the element reaches nominal dirt-holding capacity of 200 g in 35 min of dirt injection.

Totamitor readings and test-section pressure drop are recorded every 5 min and at 20 and 40 psi, test-section inlet temperature every 15 min, and totalizing flowmeter readings, screen pressure drop, and clean-up filter-separator pressure drop at the start and end of the test. The following sampling schedule is used:

Effluent-fuel AEL	5 min; 20 psi; 5, 10, and 15 min after 20 psi; 40 psi
Effluent-fuel solids	5 min; 20 psi; 5 min after 20 psi; 40 psi
Influent-fuel WSIM and IFT	Pre-test

Injection-water solids, pH, and surface tension	Post-test
Coalesced water	Periodic visual examination

e. Procedure 13-B

Same as 13-A, except no water is injected during the initial solids injection period (0 min to 20 psi).

f. Procedure 13-C

Same as 13-A, except water injection rate is increased to 0.6 gpm (3%) starting at 20 psi and continuing to end of test.

g. Procedure 13-D

Same as 13-A up to the 20-psi point; then water and solids injections are shut off, and fuel flow is continued for 8 hr additional. After an 8-hr shutdown, fuel flow is restarted, and the regular schedule of Procedure 13-A is resumed as if starting from the regular 20-psi point (15 min of 0.2 gpm water, then water plus solids to 40 psi).

h. Procedure 13-E

Same as 13-A, except solid contaminant is I-116 red iron oxide.

i. Procedure 13-F

Same as 13-A, except solids (coarse AC dust) injection rate is 25% of normal, i.e., 1.43 g/min.

j. Procedure 13-G

Same as 13-A, except following schedule is used:

0 min to 10 psi	Water 0.002 gpm, solids 5.72 g/min
Next 15 min	Water 0.2 gpm (no solids)
Subsequently	Fuel flow rate increased every 15 min in 2 gpm increments to a maximum of 32 gpm, keeping water injection rate at 1% of fuel flow rate. Water rate then increased stepwise to 1.2 gpm and later decreased to 0.032 and 0.0032 gpm.

k. Procedure 13-H

Same as 13-A, except water is injected into fuel pump suction. Also, after regular schedule is completed, solids injection is discontinued and water injection is continued at 0.2 gpm, while reducing fuel flow rate every 15 min in 2 gpm increments down to 10 gpm.

l. Procedure 13-I

Same as 13-A, except fuel flow rate is 16 gpm and water is injected into fuel pump suction.

m. Procedure 13-J

Same as 13-A, except solid contaminant is fine AC dust.

n. Procedure 13-K

Same as 13-A, except solid contaminant is fine AC dust, and water injection rate is 0.2 gpm throughout test.

o. Procedure 13-L

Same as 13-A, except solid contaminant is fine AC dust, water injection rate is 0.2 gpm throughout test, and dirt injection is scheduled as follows: First injection terminated at 10 psi, then 120 min without dirt injection, then dirt injection restarted and continued to 40 psi.

p. Procedure 13-M

Same as 13-A, except solid contaminant is Pfizer R-9998 red iron oxide.

q. Procedure 13-N

Same as 13-A, except solid contaminant is fine AC dust, and solids injection rate is 50% normal (2.86 g/min).

r. Procedure 13-O

Same as 13-A, except solid contaminant is 50% fine AC dust and 50% coarse AC dust (by weight).

s. Procedure 14

Same as 13-A, except test consists of five 4-hr cycles and a final cycle, with at least 10 min shutdown between cycles:

Each 4-hr cycle: Water 0.002 gpm throughout, solids 5.72 g/min until pressure drop reaches 20 psi.

Final cycle: Water 0.2 gpm, solids 5.72 g/min; test terminated when pressure drop reaches 40 psi.

t. Procedure 14-A

Same as Procedure 14, except solid contaminant is fine AC dust, and final cycle is omitted if pressure drop has reached 40 psi in a previous cycle. If a final cycle is necessary, it is run at the end of the fourth cycle without intermediate shutdown.

u. Procedure 14-B

Same as Procedure 14, except solid contaminant is fine AC dust, and solids injection cutoff point is 10 psi instead of 20 psi. Cycle schedule is the same as in 14-A.

2. CLAY TREATING PROCEDURE

a. General

The procedure listed here is used to clay-treat a batch of fuel in preparation for a subsequent single-element loop test. The procedure is written primarily for fuels containing FSII and corrosion inhibitors, but can be used with minor modifications for other fuels. Fuel is treated by pumping from one of the loop tanks through the clay filter, and into the other tank. This is repeated for two or four passes through the clay filter. The fuel volume treated is normally 600 gal; it may be fresh, additive-free fuel, or it may be additive-containing fuel remaining after a single-element loop test.

Fuel is not normally discarded between runs; i.e., the same fuel, plus makeup, is used from test to test. Ordinarily, the loop is not flushed between runs, and cleanup filter-separator elements remain unchanged from run to run, even when changing from one inhibitor to another. During a loop test on a filter-separator element, the clay filter is bypassed; it is used only for clay treating between runs.

b. Nomenclature

The following nomenclature has been adopted for reporting clay-filter operations:

Influent sample	Fuel drawn from line entering filter-separator test section in A1/SS loop
Clay-treated fuel	Loop influent after clay treatment, without the addition of any inhibitor
Pre-test sample	Loop influent during regular pre-test period; contains inhibitors if same were added for test
Post-test sample	Loop influent after completion of a single-element test
Fuel volume treated	Amount of fuel in system subjected to clay treatment (excluding residual fuel in clay-filter housing from previous run, which has been treated previously)
Filter throughput	Total amount of fuel passed through clay filter, based on meter readings, including repeat passes and recirculation
Cumulative	Throughput (or volume treated) since the installation of a given set of clay-canister elements
Run	Clay treatment and subsequent single-element test

c. Outline of Procedure

With the correct volume of fuel in one tank, it is pumped at 40 gpm through the cleanup filter-separator and clay filter to the other tank, then back to the first tank; the direction of flow through the cleanup filter-separator and clay filter is the same in both of the two passes. This back-and-forth pumping is repeated, if necessary, for a total of four passes. The fuel, in the original tank, is then recirculated for 5 min at 40 gpm through the cleanup filter-separator and clay filter, and the "clay treated fuel" is sampled and analyzed for WSIM, IFT, and FSII content. The clay-treated fuel may be held for a maximum of 72 hours before use in a loop test; if held longer, it must be retreated.

The clay-treated fuel is then blended with inhibitors as required for the subsequent test. It is assumed that the clay-treated fuel contains absolutely no corrosion inhibitor, i.e., that such materials have been removed 100%

by the clay treatment. The actual FSII content of the clay-treated fuel, as determined by analysis, is used to calculate the FSII makeup requirement.

The treated fuel is then used to run a single-element loop test. Pre-test fuel is analyzed for IFT and WSIM, and post-test fuel is analyzed for IFT, WSIM, and FSII content, in addition to any other analyses specified in the single-element loop test procedure.

d. Specific Test Sequences

When fresh fuel is to be charged to the loop, the system is first drained thoroughly, including the cleanup filter-separator and clay filter housings. The loop is not ordinarily flushed, nor are the cleanup filter-separator elements changed. One of the tanks is loaded with outside fuel (normally uninhibited fuel) in amount of 600 gal plus allowance for clay-filter holdup, line holdup, and losses. This fuel is recirculated for 5 min at 40 gpm through the cleanup filter-separator only, and sampled for IFT and WSIM. It is then clay-treated with four passes, after which it is used in a subsequent single-element test.

For a repeat test on the same inhibitors, no draining, flushing, or element change is required. Fuel losses in the previous test are made up with outside fuel, the fuel is clay-treated with two passes, and then used in a single-element test.

When changing corrosion inhibitor (assuming that all tests are run with FSII present in the fuel), the sequence is identical to that used for repeat tests on the same inhibitor, except that four passes are used in the clay treating.

Fuel may be reused, and the same set of clay-canister elements may be continued in service, so long as the treating continues to restore the fuel to "uninhibited-fuel quality," as evidenced by high values for WSIM and IFT.

Records on cumulative fuel volumes treated and clay-filter throughput are kept for each set of clay-canister elements, the volumes being broken down into uninhibited and inhibited fuel.

SECTION V

TEST RESULTS AND DISCUSSION

1. GENERAL

Complete test results from the single-element program are presented in the form of summary sheets in the Appendix. A number of the more important trends in these data and the conclusions derived are presented in the following sections. Complete analysis of the data, including correlation studies via computer, is in progress and will be covered in future reports.

All of the tests reported here were performed in the Al/SS loop, using a fresh military-standard element for each test. Early tests and a few special tests later in the program were performed with uninhibited JP-4 fuel, blended with inhibitors as required in the test loop. The remainder and bulk of the tests were performed with JP-5 fuel, which was also blended with inhibitors in the test loop.

During the last portion of the program, the clay filter described in a previous section was incorporated in the loop and used for base-fuel cleanup prior to test.

A short summary of the test program is given in the following paragraphs. All tests were performed with an 8-in. diameter aluminum housing, using fresh JP-5 base fuel for each test, unless otherwise specified.

Tests 48-60. Shakedown runs with Procedure 10 using JP-4 fuel, in some cases reused from test to test, either uninhibited or with FSII 0.15% and/or Santolene C (4 and 16 lb/Mbbl), AFA-1 (4 lb/Mbbl), Tolad 244 (5.5 lb/Mbbl), or Lubrizol 541 (5 lb/Mbbl).

Tests 61-62. Procedure 10; blends of antistatic additive ASA-3 and FSII in JP-4 (fresh or reused) with and without 4 lb/Mbbl of Santolene C.

Tests 63-73. Procedure 10 with JP-5 base fuel, with and without 0.15% FSII and Santolene C at 4 and 16 lb/Mbbl. Four runs (Nos. 66-68 and 71) with 6.5-in. ID insert in 8-in. housing.

Note: JP-5 base fuel in all further tests except as noted.

Tests 74-83. Studies of the effect of injection-water composition, using Procedure 10 with fuel with 0.15% FSII and with or without 16 lb/Mbbl of Santolene C.

Tests 84-86. MIL-F-8901A inhibited-fuel tests (Procedure 11) with 16 lb/Mbbl of Santolene C, no FSII.

Tests 87-90. MIL-F-8901A red iron oxide emulsion tests (Procedure 12) with uninhibited fuel.

Tests 91-99. Continuation of studies of the effect of injection-water composition, using Procedure 10 with fuel with 0.15% FSII and 16 lb/Mbbl of Santolene C.

Tests 100-124. Procedure development studies, using various test procedures, with 0.15% FSII and 16 lb/Mbbl of AFA-1 or 20 lb/Mbbl of RP-2. One run (No. 107) with transparent housing.

Tests 125-183. Further procedure development studies, using Procedure 13-A, 13-J, 13-N, 13-O or 10, with various corrosion inhibitors.

Tests 184-203. Studies of the effects of various fuel-soluble surfactants, using Procedure 13-A.

Test 204. Special test by Procedure 13-A on element previously fuel-wet, drained and stored.

Tests 205-211. Tests by Procedure 13-A on blends with AFA-1 and FSII; intended as a preliminary to evaluation of effects of antistatic additive, but discontinued because of very poor repeatability.

Tests 212-219. Tests by Procedure 13-A on antistatic additive ASA-3 in JP-4, with and without 0.10% FSII and 4 lb/Mbbl AFA-1.

Tests 220-242. Tests by Procedure 13-A or 13-J on clay-treated JP-5 with 0.15% FSII and various corrosion inhibitors.

2. VARIATION OF DIRT-HOLDING CAPACITY OF ELEMENTS

It was found early in the program that the amount of dirt loading required to give a 40-psi differential varied markedly from element to element. This is illustrated by the following data from tests by Procedure 10 on JP-5 inhibited with 16 lb/Mbbl of Santolene C.

Test no.	64	65	66	67	68	70	71	72	73	77	Avg.	Std. Dev.
% dirt load at 40 psi	100	111	71	109	134	92	106	77	86	77	96.3	18.5

It was, and still is, of considerable concern that the test-to-test variation in dirt-holding capacity is so great, since this poor repeatability obviously limits the utility of the test in evaluation of fuels and additives. At the time these data were obtained, it was postulated that the source of the poor repeatability was element-to-element variation, and nothing in the subsequent program has changed this interpretation. It is further noted that the elements would, on the average, fail under a strict interpretation of the MIL-F-8901 criteria, since the average dirt-holding capacity is below the nominal 100%, i.e., in this case, below 200 g.

3. EFFECT OF HOUSING DIAMETER ON TEST RESULTS

The 8-in. housing used in almost all of the tests reported herein will give an axial flow velocity (between housing and canister) that is rather low in comparison with commercial practice. A few tests were run with a 6.5-in. insert within the housing to increase the axial flow velocity from the original 0.21 ft/sec to 0.48 ft/sec, the latter value being in line with commercial design practice. There was no serious entrainment of free water into the effluent fuel when using the 6.5-in. housing, as demonstrated by the following data, all from tests by Procedure 10 on JP-5 containing 16 lb/Mbbl of Santolene C:

Test no.	Effective housing diameter, in.	Maximum free water, mg/liter	Fuel WSIM
64	8	1-2	60
65	8	1-2	85
66	6.5	2-3	77
67	6.5	0-1	81
68	6.5	3-4	58
70	8	0-2	66
71	6.5	12-14	77
72	8	1-2	80
73	8	0-1	60

In only one test out of the four with the 6.5-in. housing was there any indication of substantial amounts of free water in the effluent. Based on later experience, the 12-14 mg/liter that was observed is not at all unusual even when an element is functioning satisfactorily. It is concluded that

the test housing diameter, at least over the range of 6.5-8.0 in., is not a critical factor in these 20-gpm tests. It will be noted that the WSIM values showed a rather large variation and did not correlate with free water passage.

4. EFFECT OF INJECTION WATER PROPERTIES

As discussed elsewhere in this report, blends of Santolene C or certain other inhibitors el will show much lower interfacial tension values when tested against the Wright-Patterson tap water or against a synthetic medium-hardness water than when tested against distilled water. Observation of this phenomenon led to the speculation that injection-water quality and properties might be one of the critical variables in filter-separator testing. Water supplies do vary widely from one test location to another, and extreme values may be found for pH as well as for hardness and total dissolved solids. Municipally softened water supplies are often very high in pH; values in the 9-10 pH range have been cited for some cities. For example, Dayton city water and Wright-Patterson AFB water come from wells in the same formation; the raw water is about 7.5 pH. The minimal chlorination at Wright-Patterson AFB does not change the pH significantly. Dayton municipal softening results in a pH around 9.0, although this may drop off slightly before the water reaches the ultimate point of use.

A number of single-element tests were run to explore the effects of water properties on test results. In all tests, the base fuel was JP-5, with 0.15% FSII in all tests except one, and with or without 16 lb/Mbbl of Santolene C. The results are listed in Table 4. It can be seen that none of these extreme variations in water quality had any significant effect on filter-separator test results. In the case of the alkaline water samples, only the carbonate blend (Test 97) was sufficiently buffered that the coalesced water stayed well on the alkaline side throughout the test. The following pH values are of interest in this connection:

Test no.	Injection water	Injection water pH	Coalesced water pH Start	Coalesced water pH End
76	NaCl only, pH 10	10.0	7.4	7.8
92	Type B + NaOH	8.7	8.1	8.1
93	Distilled*	9.6	7.4	7.4
94	Distilled*	8.9	7.2	6.9
95	Distilled	7.1	6.6	6.8
97	Carbonate	9.8	8.8	8.8

* System contaminated with alkaline residues.

TABLE 4. EFFECT OF WATER COMPOSITION ON TEST RESULTS

Test no.[a]	Corrosion inhibitor[b]	Injection water	% dirt load at 40 psi	Maximum solids, mg/liter	Maximum free water, mg/liter
72	Yes	Type B	77	0.08	1-2
73	Yes[c]	Type B	86	0.12	0-1
74	Yes	NaCl only, pH 5 [d]	111	0.18	0-2
75	Yes	NaCl only, pH 7 [d]	106	0.02	0-1
76	Yes	NaCl only, pH 10[d]	100	0.06	0-1
77	Yes	Type B	77	0.22	3-4
78	Yes	35% FSII, 65% Type B	92	0.26	3-4
79	Yes	35% FSII, 65% Type B	120	0.00	2-3
80	No	Type B	169	0.14	0-1
81	No	35% FSII, 65% Type B	134	0.02	0-1
82	No	Type B + NaCl[e]	>200	0.05	0-1
83	Yes	Type B + NaCl[e]	89	0.12	0-1
91	Yes	Type B	126	0.24	3-4
92	Yes	Type B + NaOH, pH 9.5	109	0.28	5-6
93	Yes	Distilled[f]	89	0.01	2-3
94	Yes	Distilled[f]	109	0.08	4-5
95	Yes	Distilled	109	0.28	3-4
96	Yes	Filtered tap water	71	0.06	2-3
97	Yes	Carbonate, pH 9.5[g]	126	0.12	3-4

a. All tests by Procedure 10.

b. Base fuel JP-5; FSII 0.15% unless otherwise indicated.

c. No FSII.

d. Distilled water + 115 mg/liter NaCl + HCl to pH 5.

e. NaCl added to give total chloride content of 932 mg/liter.

f. pH still high (8.5-9.5), presumably caused by contamination from Test 92.

g. Prepared from distilled water, $NaHCO_3$, and NaOH; final blend equivalent to 121 mg/liter of $NaHCO_3$ and 55 mg/liter of Na_2CO_3.

The "Type B + NaOH" water (Test 92) did not work out satisfactorily, since the addition of caustic to adjust the pH caused a great deal of solids precipitation, contaminating the system for the following runs. The most significant test in this series is that on the carbonate solution (Test 97), which showed satisfactory performance even at the high water pH maintained throughout the test. The interfacial tension of the test fuel against this alkaline water was very low, as is generally the case for Santolene C blends. Here the IFT against distilled water was 36 dyn/cm, that against injection water only 14 dyn/cm. Nevertheless, the filter-separator element performed well in separating this fuel-water system having an IFT of only 14 dyn/cm. It appears probable that the standard ring method for IFT does not give meaningful results in terms of actual coalescence performance.

The injection waters that were blended with FSII likewise did not give any handling problems. The composition containing 35% FSII was selected because such water is approximately in equilibrium with fuel containing 0.15% FSII at the normal test temperature; i.e., there will be little or no exchange of FSII between the two phases when they come into contact. This was confirmed by the results on FSII content of the fuel, which remained at or very near 0.15% throughout the test, in contrast to the usual behavior with normal injection water, where the fuel's FSII content generally drops to around 0.02% during a test by Procedure 10. Interfacial tensior obtained with the 35%-FSII water were low, on the order of 20 dyn/cm. Nevertheless, element performance was very satisfactory.

No concerted attempt has been made to evaluate the effects of water-soluble surfactants on element performance. Some indirect indications have been given at times when the injection-water system has been contaminated inadvertently with surface-active materials during cleaning operations. On some occasions, injection-water surface tensions as low as 40 dyn/cm have been obtained, without any concomitant effect on element performance.

It must be concluded that injection-water quality and properties have little or no observable effect on inhibited-fuel tests of this type. This conclusion is valid only within the limits investigated here. For example, no study has been made of injection waters containing relatively large amounts of silt, and it is quite possible that some natural waters may have very adverse effects in plugging elements.

5. EFFECT OF ANTISTATIC ADDITIVE ON ELEMENT PERFORMANCE

The Shell additive ASA-3 is under consideration for general use to reduce static charging hazards in fuel handling. A few tests were performed during this program on ASA-3 blends. All of these tests were in JP-4 fuel, except a few in JP-5 fuel that were unsatisfactory in repeatability. The results on JP-4 blends are summarized as follows:

Test no.	Additive concn.[a] ASA, mg	Other, lb	Initial fuel properties WSIM	C. U.	% dirt load at 40 psi	Max. values, mg/liter Solids	Free water
	Procedure 10						
60	---		83	50	223	0.03	1-2
61-A	0.6		90	210	292	0.36	5-7
61-B	0.8		--	310	238	0.07	0-1
62	0.8	Snt, 4	--	310	220	0.06	1-3
	Procedure 13-A						
212	---	AFA, 4	93	15	197	0.41	8-9
213	---	AFA, 4	94	15	186	0.27	13-14
214	1	AFA, 4	63	245	129	0.48	17-18
215	1	AFA, 4	67	250	140	1.57	18-19
216	1	AFA, 4	72	260	111	0.72	18-19
217	1		85	450	320	0.14	17-18
218	1		96	380	274	0.13	5-6
219	1		92	390	309	0.08	13-14

a. ASA-3 concentrations in mg/liter; corrosion inhibitor concentrations in lb/Mbbl; all fuels contained 0.10-0.15% FSII.

Based on these limited data, it appears that the ASA-3 has no observable effect on element performance when added to uninhibited fuel or to fuel containing Santolene C, but does interact with AFA-1 to give poorer performance in dirt-holding capacity and effluent quality. This lowering of performance is accompanied by lower WSIM values for the fuel containing both additives.

The fuel conductivity for ASA-3 blends showed some tendency to decrease during single-element tests:

Test no.	61-A	61-B	62	214	215	216	217	218	219
Initial C. U.	210	310	310	245	250	260	450	380	390
Final C. U.	205	320	250	200	240	220	180	280	260

Although the general trend of the conductivities was downward, the decreases were not large in most cases, and fuel conductivity remained mostly in the range of 200-300 C.U. In some cases, the single-element tests involved rather long periods of water injection. For example, in Test 61-A, water was injected at 1% of the fuel flow rate for 164 min. Even under these rather severe conditions of water washing, the fuel conductivity did not decrease appreciably.

6. MIL-F-8901A SPECIFICATION TESTS

Tests 84-90 were run according to Procedures 11 and 12, which are very similar to the MIL-F-8901A inhibited-fuel and red iron oxide slurry tests, respectively. The test fuel was JP-5, and the inhibitor was Santolene C at 16 lb/Mbbl.

Results from the inhibited-fuel tests (Nos. 84-86) were fairly satisfactory. The free water contents of the effluent fuel samples did not exceed 10-12 mg/liter, which is not excessive in relation to the range of values normally experienced with Santolene C blends. The solids data included two high values, 1.2 and 2.4 mg/liter, but these are attributed to difficulties in the determination that were being experienced at the time. These difficulties were concerned primarily with the analytical balance, but were accentuated by the use of 1-liter fuel samples as required in MIL-F-8901A rather than the gallon samples normally used in this program. The dirt-holding capacity showed the variation from test to test (element to element) that has been observed repeatedly in this program, with a downward trend during the course of three tests on the same batch of fuel. In terms of percentage of rated dirt-holding capacity, the series gave 100, 90, and 84%. Marginal-to-failing results on dirt-holding capacity have been typical of the results obtained in this program with 16-lb Santolene C blends and the particular elements used in the program.

Of the four red iron oxide emulsion tests, the first (No. 87) was invalid because of the use of 1% water injection instead of the standard 3%. It is interesting to note that this nonstandard test gave a much higher dirt-holding capacity than the three standard tests - 284% in Test 87, in comparison with 122, 133, and 190% in the subsequent tests. Element performance on effluent solids contents was satisfactory. One severe failure occurred through passage of free water into the effluent, in Test 88. The

next test, on the same batch of fuel, gave satisfactory results on free water, and the final test, on a fresh batch of fuel, gave even better results. The one severe failure on free water passage cannot be attributed to any peculiarities in fuel history, and it appears that this is simply another manifestation of unavoidable element-to-element variations. Post-test examination and dissection of the failing element did not reveal any defects that could have accounted for the failure.

This series of tests also included a rather extensive comparison of Karl Fischer and AEL water contents with various sampling techniques. As usual, difficulties were being experienced with the Karl Fischer determinations, and it is difficult to draw any firm conclusions from the data. When averaged results are compared, the Karl Fischer results attain more significance, and comparisons are possible with AEL data. The "free water" contents from the Karl Fischer data represent the excess in total water content of the effluent fuel in comparison with that of the "clean fuel," i.e., the cleanup filter-separator effluent. The following comparisons may be made:

	Test no.	Average free water content, mg/liter K-F	Average free water content, mg/liter AEL
Inhibited-fuel:	84	4	2
	85	4	5
	86	4	6
RIO emulsion:	87	-4	1
	88	7	14+
	89	1	4
	90	0	1

It can be seen that there is a rough lineup between the two sets of figures, which is the best that can be expected since the sampling schedules were not the same for the two methods. The lineup is illustrated further by breaking the data from Test 88 into two groups:

	Avg. K-F	Avg. AEL
0-50 min	3	3
57-85 min	16	18+

These series of tests also included comparisons of AEL values with line and bottled samples of 300 and 500 ml, the latter size being standard in all of this program. The general trends were as expected: The line samples gave higher values than bottled samples, and the 500-ml samples gave higher values than 300-ml samples. The severe failure in Test 88 was picked up by all four AEL sampling methods. One anomalous result was obtained in Test 84, where a 300-ml line sample gave a value of 20+ and the corresponding 500-ml sample gave a value of 3-4 mg/liter. Bottled samples taken at the same time gave 0-1 mg/liter. This single anomalous result could stem from water entrapment in the sampling line, or possibly from a bad AEL pad.

7. FILTER-SEPARATOR TEST PROCEDURE DEVELOPMENT

A number of test procedures were explored to arrive at a satisfactory procedure for rating fuels and additives. Most of this exploratory work was performed on fuel containing AFA-1 or RP-2 corrosion inhibitor at the maximum allowable concentration (16 and 20 lb/Mbbl, respectively). Results from these tests are summarized in Table 5.

It can be seen that element performance on effluent cleanliness with respect to solids was generally satisfactory in all procedures involving coarse AC dust (Procedures 10, 13-A, 13-B, 13-C, 13-D, 13-F, 13-G, 13-H, 13-I, and 14) with one exception, in Procedure 13-B. There, when the element was first loaded with AC dust without the presence of any water, the subsequent water injection apparently broke loose a considerable amount of solids and resulted in the value of 3.17 mg/liter shown in the table. This situation does not prevail when the element is "wet" with water during the solids loading period.

Other, finer solid contaminants are not handled properly by these elements. The fine AC dust (Procedures 13-J, 13-K, 13-L, 14-A, and 14-B) tends to work through the element. This sort of occurrence is not always easy to duplicate, but it was observed in most of the tests involving fine AC dust. The two red iron oxides included in this program, I-116 and R-9998, are far too fine for retention by these elements when the test is run with inhibited fuel.

The fine AC dust also tended to have a detrimental effect on the coalescing ability of the elements. Again, this trend was not clear-cut, and the single tests by a given procedure in this series are not any basis for firm conclusions. Rather, the trends noted here were used to define the more logical avenues of further development.

TABLE 5. SUMMARY OF SINGLE-ELEMENT TEST RESULTS FOR PROCEDURE DEVELOPMENT

Procedure	WSIM	Dirt load, % of rated 20 psi	Dirt load, % of rated 40 psi	Max. values, mg/liter Solids	Max. values, mg/liter Free water	Max. Totam.	Remarks[a]	Run no.
AFA-1, 16 lb/Mbbl[b]								
10	59	183	206	0.12	7-9	0	8901A type test	100
13-A	61	120	129	0.30	4-6	1	Dirt first	101
13-B	55	123	132	3.17	14-16	4	Dirt loaded dry	102
13-C	63	89	94	0.44	10-12	3	3% water after loading	103
13-D	69	117	137	0.35	3-4	1	8-hr cycle	104
13-E	62	>166	---	23.19	0	67	RIO (I-116)	105
13-F	61	89	100	0.06	5-7	0	Dirt rate 25% normal	106
13-J	83	80	80	3.58	18-20	28	Fine AC	150
13-M	50	132	132	19.92	---	45	RIO (R-9998)	124
14	54	94	120	0.24	17-19	0	Five 4-hr cycles	108
14-A	79	83	83	5.40	14-16	10	Fine AC, 2 cycles	121
14-A	66	86	86	1.31	20+	8	Fine AC, 4 cycles	122
14-A	66	123	123	0.69	20+	10	Fine AC, 1 cycle	123
RP-2, 20 lb/Mbbl[b]								
10	31	160	177	0.20	8-10	0	8901A type test	110
13-A	34	94	100	0.15	10-11	1	Dirt first	109
13-G	43	49[c]	---	0.37	20+	51	Varying flow rates	111
13-H	43	77	86	0.12	20+	70	Water to fuel pump	112
13-I	68	100	112	0.36	8-9	17	ditto, fuel 16 gpm	114
13-J	32	80	80	16.12	20+	21	Fine AC	115
13-K	49	89	89	0.57	11-12	3	Fine AC, water 0.2 gpm	116
13-L	50	114[c]	143	2.53	14-15	9	ditto, 2-hr run	117
14-A	48	80	80	4.30	17-18	16	Fine AC, 1 cycle	118
14-A	47	77	77	11.68	18-19	14	Fine AC, 1 cycle	119
14-B	39	112[c]	112	0.09	20+	9	Fine AC, 1 cycle	120

a. Remarks refer to difference of given procedure from Procedure 13-A

b. All fresh-fuel blends in JP-5 with 0.15 vol. % anti-icing additive.

c. Dirt load at 10 psi.

Subsequent work was concentrated on Procedures 13-A and 13-J, using coarse and fine AC dust, respectively. In both of these procedures, the element is loaded with dirt to 20 psi while injecting water at 0.01% of fuel flow. Then, dirt loading is discontinued, and the water rate is increased to 1% of fuel flow. After 15 min of this 1% water injection, provided the pressure drop is still below 40 psi, the dirt injection is resumed and continued to 40-psi loading. When using fine AC dust, the element will rarely go for the full 15 min of 1% water injection without exceeding 40 psi.

Tests were run by Procedures 13-A and 13-J, using various corrosion inhibitors in the fuel, for comparison with Procedure 10. In addition, some tests were run by the modified procedure 13-N, in which fine AC dust is injected at 50% of the normal rate to give a 70-min period for loading to nominal capacity, and Procedure 13-O, in which the dirt consists of 50% fine and 50% coarse AC dust. In order to reduce these data to a form that is convenient for examination, an arbitrary rating scale has been set up, based on the maximum observed solids, free water, and effluent Totamitor readings during the test. Ratings on this scale are summarized in Table 6.

It will be noted that the corrosion inhibitors are divided into two groups by either procedure 10 or 13-A. The Santolene C, AFA-1, RP-2, and Unicor M give passing results, while the Toiad 244 and Lubrizol 541 give bad results when used at the maximum allowable concentrations. The Na-Sul EDS was included in these tests because of its former status as an inhibitor qualified for use in jet fuels. As expected, this inhibitor gave severe failures in coalescence in these tests.

The use of fine AC dust (Procedure 13-J) results in a much more severe test, and failures are the rule rather than the exception. Since the pass-fail criteria are purely arbitrary, the test "severity" could be altered at will by changing these criteria. However, for a test to be useful in rating inhibitors, it would have to be repeatable; and Procedure 13-J does not give repeatable results. Both dirt retention and coalescence are in a rather critical balance when using the fine AC dust, and the test-to-test variations in results are extreme in the case of the 16-lb Santolene C blends. Part of this difficulty may be caused by the very rapid schedule of events in this test procedure. Pressure drops increase very rapidly when the water injection rate is increased, and close control over the sampling schedule become impossible. Procedure 13-N was set up to ease up on this schedule by injecting the dirt at a slower rate. However, the test repeatability was not improved, as evidenced by the results on Santolene C blends. The use of a mixture of 50% fine and 50% coarse dust (Procedure 13-O) did not improve the situation.

TABLE 6. GENERALIZED RATINGS ON CORROSION INHIBITORS BY DIFFERENT TEST PROCEDURES

Inhibitor	Concn., lb/Mbbl	Ratings in individual tests by indicated procedure				
		10	13-A	13-J	13-N	13-O
Santolene C	4	A		D	A E	
	16	A[a]	C	E B C A D	E B	C D A
AFA-1	4			E	E	
	16	A	A	E E E E	E E D	C D
RP-2	7			C	D	
	20	A	B	E D	D	A
Unicor M	9		A	E D		A E
	20	B	B	D D D		D E
Tolad 244	5.5		D			
	20	E	E	E		
Lubrizol 541	5		D			
	20	E	E	E		
Na-Sul EDS	14.5	E	E	E		

All tests in fresh JP-5 with 0.15 vol. % FSII.

Tests through No. 183 included in these ratings

	Solids	Free water	Totamitor
A - very good	<0.4	<10	<5
B - pass	<0.6	<15	<10
C - marginal	0.6-1.0	15-20	10-15
D - fail	>1.0	20+	>15
E - very bad	>2.0	30+++	>30

A test is classed as A or B only if all three of the ratings meet the requirements. It is assigned the lower rating class of C, D, or E according to the worst rating of the three parameters.

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a. Six tests rated A, one test rated B.

There would be little advantage in deviating from the standard MIL-F-8901A inhibited-fuel test procedures unless gains can be demonstrated in discrimination among additives, or repeatability can be improved, or a more realistic test in terms of field conditions can be developed. Thus far, attempts to develop a more critical test in terms of discrimination among additives have led to extremely poor repeatability. Extensive comparisons of repeatability of results on different additives are not available for Procedure 10, the procedure most closely resembling the 8901A procedure. Results on 16-lb Santolene C blends with Procedure 10 have shown repeatable results so far as effluent quality is concerned, but the dirt-holding capacity results are extremely variable, as discussed previously in this report.

Procedure 13-A is considered to be more "realistic" in terms of field conditions than is Procedure 10 or the 8901A procedure, where the element and fuel are water-washed by 60 min of 1% water injection before the really critical part of the test commences. If icing inhibitor is present in the fuel, it will be largely removed by such washing, and other effects on the fuel and element are certainly possible. The actual extraction of FSII from the fuel has been found to approximate the equilibrium condition with a distribution coefficient of 200/1 between the water and fuel phases. Introducing some simplifying assumptions, the equation governing this extraction is

$$\log B/B_o = \frac{-200\ RF}{2.3\ V(1 + 200R)}\ t$$

where B = inhibitor concentration in fuel at time t,
B_o = initial inhibitor concentration in fuel,
V = total fuel volume in system,
F = fuel flow rate, and
R = water injection ratio (water rate/fuel rate).

For tests in the Al/SS loop, V = 600 gal, F = 20 gpm, and R = 0.01 for 1% water injection. If the initial FSII concentration B_o = 0.15%, the equation reduces to

$$\log B = -0.821 - 0.00968\ t$$

where B is in volume % and t is in minutes. From this equation, it is found that 60 min of 1% water injection will extract 74% of the original FSII, i.e., the concentration in the fuel after 60 min is 0.039%. Experience has indicated that actual results follow this equation fairly well.

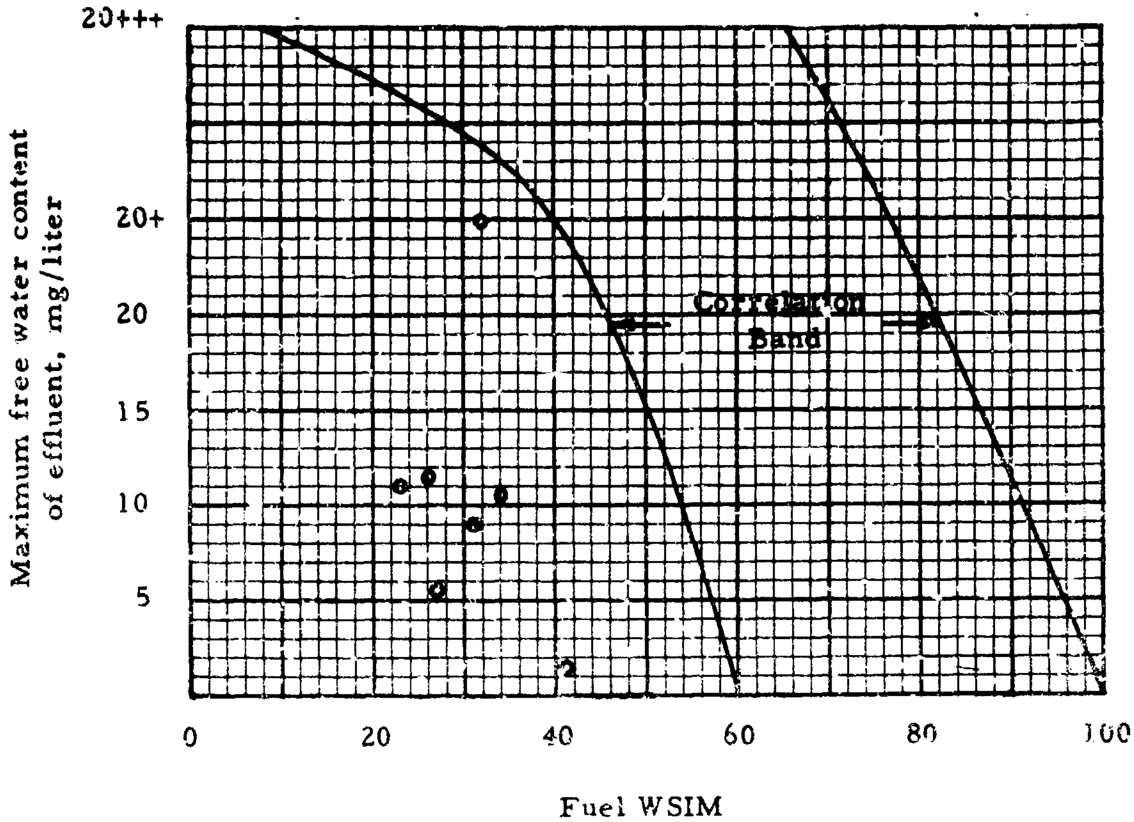
Assuming that it is desirable to avoid this initial water-wash procedure in testing fuels and corrosion inhibitors, the most feasible approach is to load the dirt to (say) 20 psi with a minimum amount of water injection, then enter the critical part of the test. Loading with dry dirt without water is unrealistic in the other direction. Procedure 13-A represents the best compromise in this respect, using 0.01% water injection during the initial dirt loading period, and Procedures 13-J and 13-O have followed the same schedule.

A thorough evaluation of test repeatability has been delayed by the question of fuel-blend repeatability. Considerable care has been taken in handling and blending the fuel to ensure that the fresh fuel-inhibitor blend for each test is made up in the same manner. Nevertheless, one cannot assume that fuel remains the same from day to day, and certainly not that one can obtain a new batch of fuel, even from the same refinery, that will match the previous batch exactly. For these reasons, some form of clay treatment has been adopted for base stock preparation in much filter-separator test work, and such treatment is specified for the inhibited-fuel test in the proposed MIL-F-8901B.

It is not yet firmly established to what extent the test-to-test variations in the single-element program may be attributed to fuel/additive variation, and how much to element-to-element variation. All of the data from this program are being prepared for computer analysis. At the same time, new series of single-element tests have been initiated in which the base fuel is clay-filtered prior to each run, to determine whether cleaning up the fuel (and thus eliminating major fuel and fuel/additive variations) will improve the test repeatability to any great extent. At the time of writing this report, the test program on clay-filtered fuel is still in progress. Although the results have not yet been analyzed in any depth, preliminary indications are disappointing; this lends strength to the presumption that element-to-element variations are indeed the major factor influencing test repeatability.

8. CORRELATION BETWEEN WSIM AND SINGLE-ELEMENT RESULTS

Although computer-programmed analysis of this correlation (or lack thereof) is still pending, certain conclusions can be drawn from simple examination of the data. Results from a group of tests by various procedures are shown graphically in Figure 3. Most of the points relating effluent free-water content to fuel WSIM fell within a broad band. The points outside this band represent blends of RP-2 or Unicor M. In general, these inhibitors give very low WSIM values in relation to their effects on single-element performance. For example, in one run on a Unicor M blend, the maximum



Notes: Data from single-element tests through No. 165 on inhibited JP-5 fuels by Procedure 10, 13-A, 13-J, or 13-N.

Out of a total of 55 data points, 48 fall within band between curves.

Seven points outside band are RP-2 or Unicor M blends.

FIGURE 3. RELATION BETWEEN FREE WATER IN SINGLE-ELEMENT TESTS AND FUEL WSIM

free water content observed was only 5-6 mg/liter; yet the fuel WSIM was 27, which would normally be considered to be indicative of extremely poor coalescence properties.

For purposes of reference, the seven points shown in the figure represent the following tests:

109	RP-2	20 lb/Mbbl	Procedure 13-A
110	RP-2	20 lb/Mbbl	Procedure 10
115	RP-2	20 lb/Mbbl	Procedure 13-J
136	Unicor M	9 lb/Mbbl	Procedure 13-A
137	Unicor M	20 lb/Mbbl	Procedure 13-A
138	Unicor M	20 lb/Mbbl	Procedure 10
139	Unicor M	20 lb/Mbbl	Procedure 13-J

Quite obviously, the "correlation band" shown in the figure does not cover such inhibitors, which may have relatively mild effects on coalescence in filter-separator elements but depress the WSIM very markedly.

If the right-hand boundary of the band represented a firm boundary, then one could set WSIM limits corresponding to any given free water content of the effluent fuel. For example, a minimum WSIM of 80 would ensure against any serious failures in coalescence, and a minimum WSIM of 90 would guarantee that the free water content of the effluent would not be much over 10 mg/liter. Unfortunately, this boundary is by no means firm. As discussed in the next section of this report, some surfactants can have extremely adverse effects on coalescence without much effect on the WSIM value.

In view of the poor situation on repeatability of separometer results, not too much reliance can be placed on these values as a guide to effects on coalescence.

9. EFFECT OF SULFONATES AND NAPHTHENATES ON COALESCENCE

The effects of four fuel-soluble surfactants were studied by means of single-element and separometer tests. The materials studied were as follows:

Petronate L - sodium sulfonate, commercially available, 62% active ingredient, 425 mol. wt.; typical of sulfonate emulsifiers used in "soluble oils" and similar products.

Petronate CR - same, but 513 mol. wt.; typical of sulfonates used in rust preventives.

Naphthenate N-A-1 - sodium naphthenate, laboratory-prepared, 25% active ingredient, 332 mol. wt. This was prepared from Sunaptic A acids, which are derived from lube oil treating and are higher in molecular weight than conventional gas-oil or kerosine naphthenic acids; hence, the sodium salts of these acids are more oil- and fuel-soluble than are conventional sodium naphthenates.

Naphthenate N-C-2 - same, but 437 mol. wt.; made from Sunaptic C acids, which represent the top end of the molecular weight range available.

Single-element tests on blends of these surfactants in JP-5 fuel indicated rather extreme differences in effects on element performance. The following ratings are based on the same arbitrary scale used previously in this report (see Table 6), except that here separate ratings are given for the water and solids performance. All tests were performed by Procedure 13-A.

Petronate L, mg/liter:	0.02	0.05	0.20	1.0			
Solids rating	A	E E	E	E			
Water rating	A	D E	E	E			
Petronate CR, mg/liter:	0.02	0.05	0.10	0.20	0.25	0.50	1.0
Solids rating	A	A	A	A	C C	E	E
Water rating	A	A	A	B	A A	B	D
N-A-1, mg/liter:	0.50	1.0	5	10			
Solids rating	D	E	E	E			
Water rating	A	A	D	C			
N-C-2, mg/liter:		1.0	10	50			
Solids rating		B	D	E			
Water rating		A	A	A			

The sulfonates were effective in disrupting the coalescence operation at much lower concentrations than were the naphthenates, and, for each class, the lower molecular weight material had the greater effect. A better comparison can be made by bringing the surfactant concentrations to a common denominator in terms of active ingredient:

	Sulfonates		Naphthenates	
	L	CR	N-A-1	N-C-2
Minimum concentration for failure, mg/liter active ingredient	0.031	0.31	0.12	2.5
Type of failure (solids, water)	Both	S	S	S
Mol. wt. active ingredient	425	512	332	437
Mol. wt. of hydrocarbon radical in active ingredient	322	410	265	360
Approx. no. C atoms in radical	24	30	19	26

Within the molecular weight range covered in each class, the effects on filter-separator performance decreased with increasing molecular weight. However, not enough different molecular weights were covered to establish whether any one of these materials represents the maximum-effect molecular weight. Such a maximum-effect phenomenon is typical of most homologous series in emulsifying power and other surface-related properties. The Petronate L is widely used for emulsification, and it may well be near the "optimum" molecular weight. The fact that the sulfonates had greater effects in these tests than did the naphthenates cannot be generalized, since one cannot be sure that the naphthenates are anywhere near the "optimum" molecular weight for that class. It is quite possible that a naphthenate midway in molecular weight between the N-A-1 and N-C-2 could have optimum (worse) effects than either. Structural effects as well as molecular weight will determine the relative emulsifying power.

WSIM values of the surfactant blends are plotted against surfactant concentration in Figure 4. The curves for the Petronates and for the N-C-2 are reasonably smooth, with little scatter (except one point off curve for the Petronate CR). The data on the N-A-1 naphthenate are badly scattered. Since only four data points are involved, this behavior of the N-A-1 could be mere coincidence, or it could reflect more serious effects of adsorption for this particular surfactant. Since the N-A-1 is the lowest in molecular weight and presumably the least fuel-soluble of the four surfactants, it would be expected to show the strongest adsorption on sample-container surfaces. It is in fact rather surprising that the data on the other surfactants are as regular, since adsorption could change the concentrations significantly. For Petronate L, monomolecular adsorption on the walls of a 1-gallon container would be expected to remove about 0.33 mg of active ingredient from the bulk liquid. Many of the Petronate L blends contained far less than this amount of active ingredient.

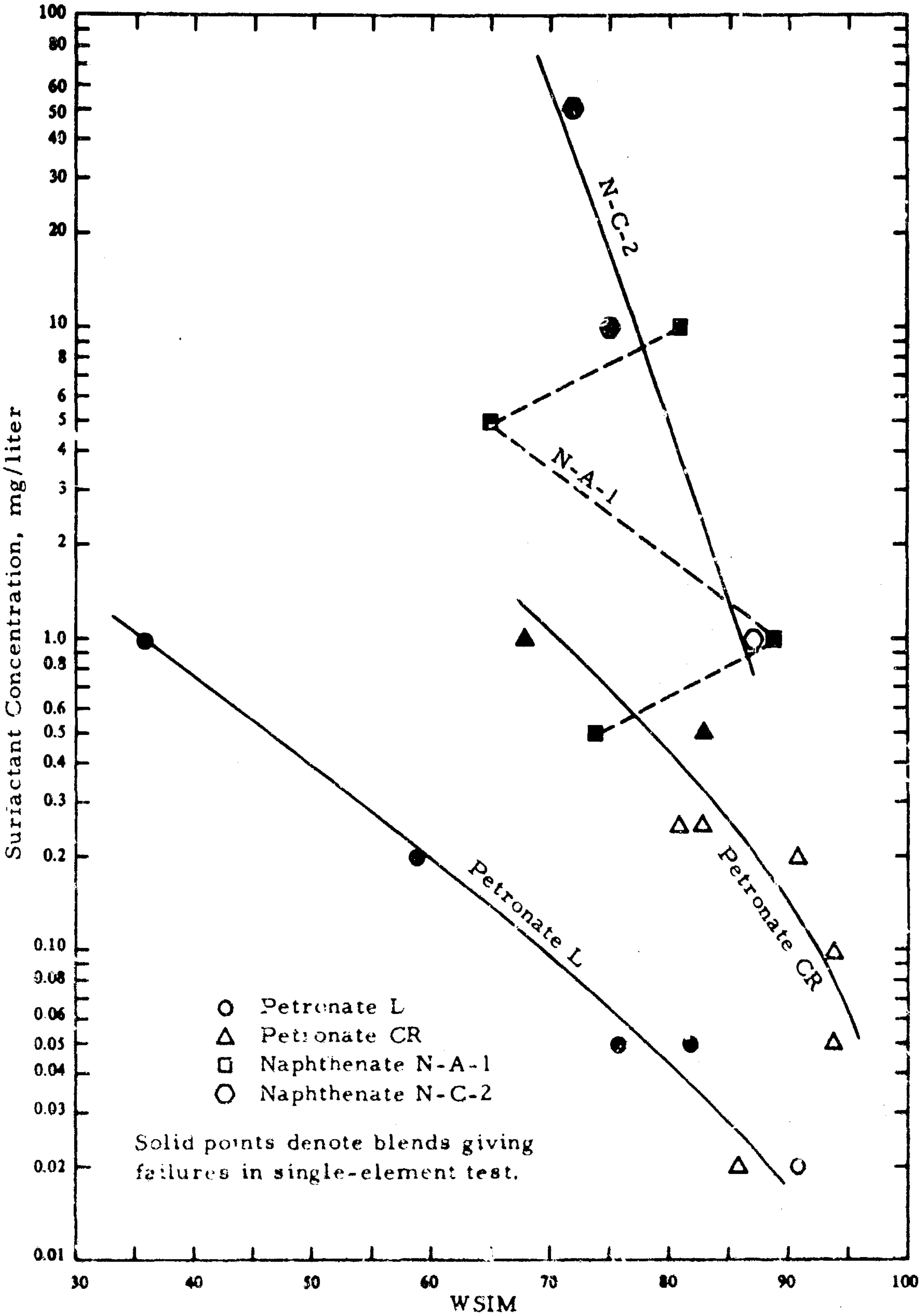


FIGURE 4. EFFECTS OF SURFACTANTS ON WSIM AND ELEMENT PERFORMANCE

In Figure 4, the blends that gave failures in the single-element tests are indicated by solid points. It will be observed that failures were obtained at WSIM values above 70 for all surfactants, and at WSIM values above 80 for three of the surfactants. This statement includes filtration failures (solids) as well as coalescence failures (water). The picture on coalescence failures alone may be seen more clearly in terms of the effluent-water vs. WSIM plot shown previously as Figure 3. Three of the data points for the surfactant blends will fall to the right of the boundary curve:

Petronate L, 0.05 mg/liter:	WSIM 82, free water 20+ mg/liter
ditto	WSIM 76, free water 20+++ mg/liter
Petronate CR, 0.05 mg/liter:	WSIM 94, free water 8-9 mg/liter

The two points for the Petronate L represent the only clear-cut coalescence failures that have been encountered in this program at such high WSIM values.

Incidentally, the coalescence failures in such tests are generally quite rapid. For example, in Test 185 (0.2 mg/liter of Petronate L), the Totamitor started to indicate serious contamination after only 10 min of dirt and water injection. The function of such surfactants seems to be an immediate disruption of the coalescence and filtration processes, rather than the gradual "disarming" of the coalescer by adsorption of the surfactant, which is often cited as a mechanism of failure in field service.

The interfacial tension values on these blends were in the range of 37-46 dyn/cm, which is normally associated with "good" fuel that will offer no problems. All of these values refer to the standard ASTM platinum-ring method for surface tension. These particular blends were also checked by the hydrophobic-ring technique, both immediately after forming the interface in the IFT test and after aging the interface for 16 hr. Values down to 26 dyn/cm were obtained on the aged interfaces, but nothing low enough to have predicted the drastic effects on coalescence that were encountered.

All of the surfactants gave filtration failures (passage of solids), usually at a surfactant concentration where coalescence performance was still reasonably satisfactory. Such a role of surfactants has not been publicized nearly as much as their role in affecting coalescence. The question naturally arises as to whether this effect is indeed an actual or potential problem in the field, or whether it is peculiar to our particular test conditions. In these tests, the highest solids contents in the effluent fuel normally occurred in the sample taken at 20 psi. At this point in the test period, the dirt feed has just been turned off and the water injection rate has been increased

from 0.01 to 1%. Even though this increase is accomplished gradually and carefully, it evidently forces some dirt through the element. With the coarse AC dust used in these tests, no such "unloading" occurs except in the presence of surfactants or certain corrosion inhibitors that have similar effects. With the surfactants under discussion here, large amounts of solids may pass through the element at other times in the test sequence, and there is a definite trend toward regular passage of solids at concentrations of 0.5-1.0 mg/liter in the effluent even when no severe failure is being observed in either filtration or coalescence. An example of this behavior may be seen in Test 196, with 0.5 mg/liter of Petronate CR, where a solids content of 0.46 mg/liter was observed 5 min after the start of the test, 2.25 mg/liter at the 20-psi point, 0.65 mg/liter at 5 min later, and 0.59 mg/liter at the 40-psi point. During all of these operations, the free water content of the effluent did not exceed 10-12 mg/liter.

The surfactants also tend to decrease the dirt-holding capacity of the element, i.e., to plug it faster. The dirt-holding capacity was above 100% rated capacity in all tests in which filtration performance (effluent solids) was rated as "very good." When filtration performance was rated as "very bad," i.e., when excessive amounts of solids were coming through into the effluent, the dirt-holding capacity was also low. In other words, plugging and passage of solids through the element tended to go together. There were some exceptions to this rule, generally when coalescence failures were occurring at the same time. It may be theorized that the finely divided water passing through the element at such times tends to wash along the solids and thus minimize plugging but accentuate the passage of solids.

It would appear that surface-active materials may act both as dispersants and as emulsifying agents and thus affect filter-separator performance adversely from two directions. For any given surfactant, as the concentration is increased, one of these phenomena may become evident before the other.

This picture is based on rather broad extrapolations and inferences. However, it may be useful in interpreting filter-separator test and field performance data. This picture also suggests that fuel quality control should include some type of dispersancy test as well as a coalescence test. No work has been done along this line in this program.

10. EFFECT OF ELEMENT DRAINING AND STANDING

It has been suggested that filter-separator elements may be affected adversely when they are drained of fuel and allowed to stand for a few days or weeks. One test was run in this program as a check on this phenomenon. In this test (logged as Nos. 203-A and 204), an element was

installed in the regular test housing with canister and subjected to uninhibited JP-5 fuel flow with 1% water injection for 60 min, after which the housing was drained of fuel, sealed, and left with element and canister undisturbed for two weeks. At the end of that period, it was subjected to a test by Procedure 13-A on JP-5 inhibited with 16 lb/Mbbl of Santolene C and 0.15% FSII. The element performed satisfactorily up to 20 psi, but thereafter there was a gross failure in coalescence, with effluent water contents of 20+++ mg/liter being recorded. It is not possible to relate such "20+++" ratings directly to the actual water content, but, from some rough correlations, it is believed that a rating of 20+++ based on pad color will generally correspond to free water contents above 100 mg/liter.

This sort of failure is highly unexpected for Santolene C blends. Although this single test cannot be conclusive, the results do suggest the need for more work in this area.

11. CLAY TREATMENT OF BASE FUEL

During the last few tests reported here, a three element clay filter was installed for treating the base fuel prior to each single-element test. The total amount of clay in the three elements is approximately 21-1/2 lbs. For successive tests on inhibited fuels, it was assumed that the clay filter would remove all of the corrosion inhibitor or other surface-active material remaining from the previous test, and the fuel would then be reblended with additives to the desired concentration.

It was found that clay treatment restored the fuel WSIM to the high 90's in all cases. The original set of elements installed in the filter finally failed, as evidenced by a drop-off in WSIM of the treated fuel. At that time, the cumulative throughput for this 40-gpm filter was 33,300 gal, including multiple passes and recirculation in the total. The cumulative fuel volume treated was 12,000 gal, of which 1,641 gal was uninhibited fuel and 10,339 gal was inhibited fuel. It was calculated that the total amount of inhibitors passed into the clay elements, and presumably retained there, was about 4 lb, roughly 50% Santolene C, 25% AFA-1, and 25% RP-2. The failure finally came while RP-2 blends were being tested. Installation of new clay-filter elements and subsequent treating restored the base-fuel quality to a high level.

Complete data on single-element tests completed during this period and involving clay-treated base fuel are included in Appendix A. These results will not be discussed in detail in this report, as additional runs are needed (and are in process) to establish whether clay treating will improve the repeatability of test results.

SECTION VI

SMALL-SCALE COALESCENCE APPARATUS

In investigating the utility of various media in coalescing water droplets dispersed in fuel, it is necessary to have some sort of small-scale apparatus, since full-scale testing obviates any extensive screening program and introduces complications of its own. Other investigators have made use of the ASTM-CRC water separometer for this purpose. This instrument has one primary advantage - availability - and many disadvantages. Among the major disadvantages, one may cite the lack of precise control over the water dispersion procedure, the limitation on the amount of test fuel that can be handled on a once-through basis, the absence of any indication of test-cell pressure differential, the lack of independent control of media density, the reliance on turbidity measurements as an indicator of coalescence efficiency, and the possible effects of pump wear debris on media performance. As an instrument for routine quality control, the separometer is useful but is presently subject to poor repeatability and reproducibility of results. Rather than attempt to "improve" the separometer for use in research on media, we have taken the route of development of new apparatus.

This development and design have gone through several stages, and there will undoubtedly be other changes made as the work progresses. Here we will describe the apparatus in its present form.

It was decided to design the apparatus on the basis of a fuel throughput of 0.05 gpm. Premix of fuel and water was not desired, since time-dependent interactions among fuel, water, and inhibitor during long-term runs would introduce new variables that would be very difficult to interpret. Instead, it was decided to inject water directly into a flowing fuel stream entering some type of mixer of homogenizer.

Most laboratory homogenizers or mills are far too large for this application. The model finally selected, a Manton-Gaulin laboratory homogenizer, is somewhat oversize for satisfactory service at 0.05 gpm, since operation at this low throughput would create excessive heating of the fluid. This problem was solved by operating the homogenizer at 0.2 gpm, discarding about 75% of the fuel-water stream through a back-pressure regulator that also serves to maintain a constant supply pressure to the coalescer cell.

A flow plan of the apparatus in its present form is shown in Figure 5. Fuel and water are fed under helium pressure into the homogenizer

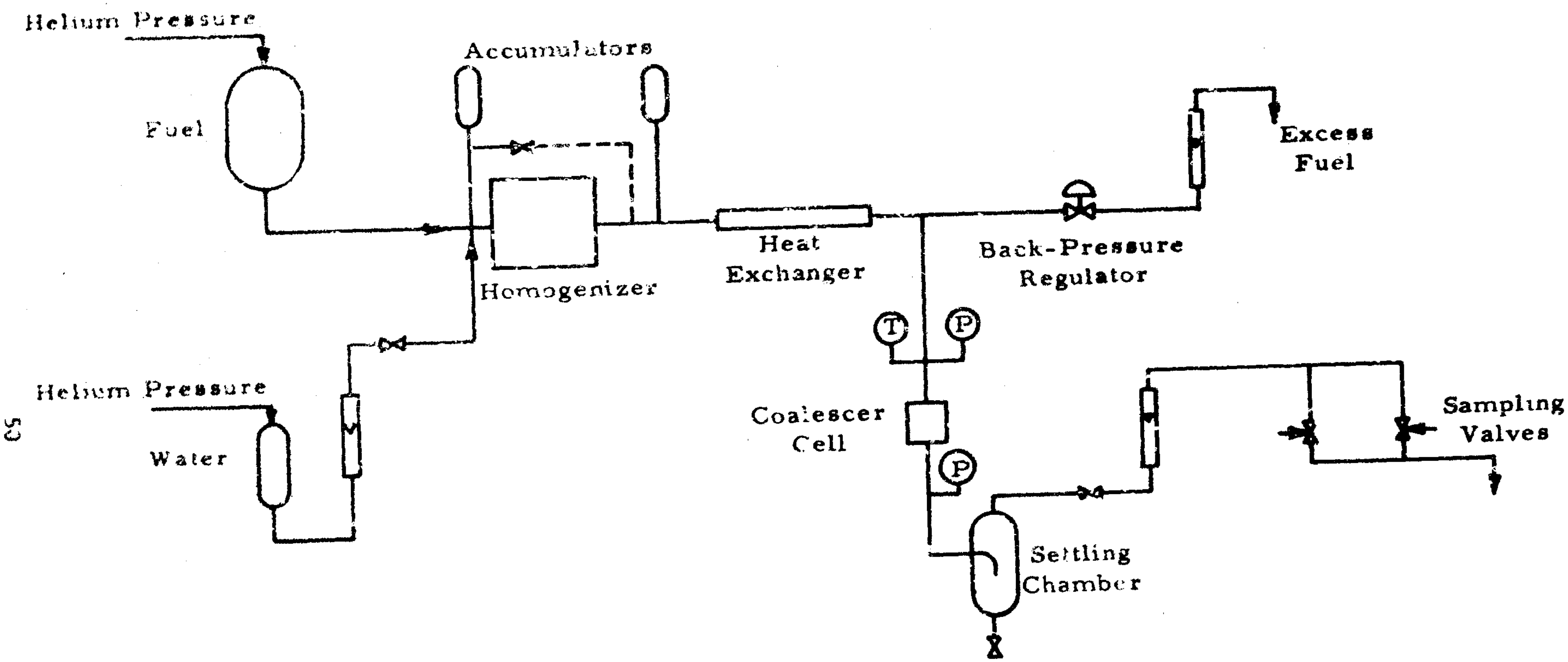


FIGURE 5. FLOW PLAN OF SMALL-SCALE COALESCENCE APPARATUS

inlet. The water injection line is 1/16-in. tubing that is fitted into the homogenizer inlet so that the entering fuel stream carries the water on into the homogenizer, without any possibility of holdup. The fuel reservoir is a 15-gallon stainless steel pressure vessel. With the present flow plan, the fuel reservoir is pressurized to only 20 psi, since the only function of the pressurization is to move the fuel into the homogenizer. The water reservoir is pressurized to 40 psi. Both reservoirs are designed for much higher pressures.

The homogenizer is essentially a high-pressure piston pump with a variable-area, spring-loaded orifice. Homogenizer discharge pressure is normally set at 500 psi to minimize the heating effect. The homogenizer is capable of operation at much higher discharge pressures, but 500 psi is sufficient to give efficient and reproducible dispersion of water in fuel. The pulsating flow of this type of a homogenizer is a considerable disadvantage for use in this apparatus, and several design changes were made before the present flow plan was established. The use of two accumulators, properly placed, smooths out the flow sufficiently that very little pressure fluctuation is observed at the coalescer cell.

The water-in-fuel dispersion from the homogenizer passes through a heat exchanger for temperature control and is then split into two streams. The larger stream passes through a back-pressure regulator and rotameter and is discarded. The back-pressure regulator is normally set at 70 psi. The smaller stream is supplied at 70 psi to the coalescer cell; it then flows through the settling chamber and rotameter, thence to a sampler or to waste.

The coalescer cell is designed for independent loading of multiple layers of the same or different media, each with independent control of degree of compression. This was achieved by the use of separate sub-assemblies within the cell. Such a design creates complications in loading and sealing the cell, but the independent control on each layer of media is considered to be an absolute necessity.

The settling chamber is glass, of the same general configuration as that of the ASTM separometer. However, it is designed for operation under pressures up to 100 psi, so that system pressure can be maintained through and past this point. This arrangement prevents any difficulty with gas evolution, since the depressurization point (the needle valve for flow regulation) is beyond the test section. The original settling chamber was small, on the order of the separometer settling chamber. Early operation indicated that entrainment of fairly large water droplets was occurring, so that the effluent would contain fairly large amounts of free water even when the coalescing section was functioning efficiently. This same difficulty, by

the way, is present in operation of the separometer. For the separometer, the difficulty was resolved, in effect, by ignoring it. That is, the turbidity meter in the separometer is insensitive to relatively large amounts of water so long as it is not very finely dispersed; hence, a "good" separometer reading can be obtained with large amounts of free water in the effluent. This solution was not considered satisfactory for the present small-scale apparatus. A larger settling chamber was designed and fabricated recently, and this appears to have resolved the problem.

The major problem that has not been resolved is that of how to place a quantitative rating on effluent quality. Turbidity measurements are considered unsuitable because of the major influence of degree of dispersity of the water. Most of the efforts in this direction have been directed toward the use of the AEL free water detector. This apparatus and technique have two limitations for this application. The top end of the rating scale is 20 mg/liter, so there is no possibility of even semiquantitative comparisons above that level. The other problem is the poor flow pattern and fluorescence pattern obtained with the AEL apparatus at the low flow rates involved. The question of how to rate effluent quality has not been resolved satisfactorily, and in fact this has been one of the major limitations to successful use of this apparatus.

Most of the operation of this unit to date has been in the category of design refinement and shakedown testing, and it does not appear pertinent to present data at this time. In general, it may be said that satisfactory operation has been achieved, but the major problem of assigning a quantitative performance rating has not been resolved. During the course of the design refinement and shakedown testing, numerous problems in flow control had to be resolved. For example, water flow rates below 1 ml/min have to be maintained and measured accurately. Damping of the pulsations of the homogenizer and proper arrangement of accumulators, homogenizer, and water injection system required considerable study and redesign. These problems have been resolved, and full use of the apparatus is limited only by the problem of effluent rating.

In most of the initial operation of this apparatus, fiberglass media have been used in the coalescer cell. Even within the general class of resin-bonded glass fiber blanket, materials varying widely in structure and properties are available commercially, many of them quite well defined by specifications. Within this class, proper selection of commercial materials will make it possible to study the effects of bed geometry and fiber surface properties, along with the effects of fuel composition and flow parameters. Numerous samples of such materials have been obtained for these studies.

In considering the possibilities for broader use of this apparatus, it may be seen that it is not readily adaptable for studies of solids removal, at least not so long as it is operated on the principle of direct injection of contaminants. The problems involved in metering and injection of such small amounts of solid materials are extremely difficult. For example, even if the bed were to be loaded with solids over a relatively short period, say 30 minutes, the solids injection rate would be only 1.7 mg/min. A more logical approach to such studies might be the use of a nonpressurized fuel reservoir and predispersal of the solids in the fuel supply. An alternate approach would be preloading of the coalescer cell assembly with solid contaminant in a separate apparatus, then transferring the cell to the coalescence apparatus to measure performance on the loaded cell.

One potential advantage of a small unit is the possibility of long-term exposure of media to rather large amounts of fuel on a once-through basis, i. e., a simulation of actual field conditions without the requirement for extremely large volumes of fuel. For example, at 0.05 gpm, about seven drums of fuel would be required for a 125-hr life test. The apparatus as it is presently set up would not be convenient for such tests, in view of the limited size of the fuel reservoir and the need for constant attention of an operator during the actual run. For exposure of media to large volumes of fuel, it would be more convenient to set up a separate, simple apparatus, preferably with gravity feed of fuel, that could run unattended. Media after such treatment could then be evaluated in the regular coalescence apparatus.

SECTION VII

MISCELLANEOUS

1. WATER SEPAROMETER

a. General

The ASTM water separometer was used routinely in conjunction with the loop tests reported herein as a check on fuel quality, and for possible correlation of WSIM and single-element results. Additional work on the separometer was performed to study the variability of coalescer disks, to define the effect of antistatic additive on WSIM values, and to determine the relationship between WSIM values and Esso Mini-Separometer values.

b. Coalescer Disk Variability

A continuing problem during this program has been the interpretation of WSIM results. It has long been suspected that lot-to-lot variations in the coalescer disks have very significant effects on the WSIM rating level. The two disks used in each separometer test include a "coarse" disk cut from ordinary fiberglass mat of the building-insulation type, and a "fine" disk cut from a filter-grade fiberglass mat. The manufacturer's quality control on these disks consists of measuring the pressure drop across each disk when it is installed in an old-style coalescer cell (used in the original WSI test) with air-flow through the disk established at 8 liters/min. Pressure-drop limits are set at 2.0-3.2 cm water for the coarse disks and 16.5-19.5 cm water for the fine disks. When the manufacturer is obliged to adhere to these limits, there will necessarily be a rather large variation in weight of the individual disks, since the fiberglass itself is so variable as to preclude any simple relation between amount of medium (weight) and air-flow resistance.

During this program, it was first realized that serious anomalies were occurring in the WSIM results when checks were run on uninhibited JP-5 fuel being used as the base fuel for single-element tests. Fuel that had been rated at 95-100 WSIM by the producer, and that continued to be rated at this level by other laboratories, would often be rated in the 80-90 WSIM range by our laboratory. After a considerable investigation, it was determined that the prime cause of this discrepancy was in the coalescer disks themselves. A log of the WSIM tests run during one such period is presented in Table 7. Direct comparisons on the same sample of uninhibited JP-5 with separometer disks from three sources (Runs 7-12) showed that the SwRI

TABLE 7. SEPAROMETER DATA

Test no.	Disk source[a]	Disk wt., mg Coarse	Disk wt., mg Fine	Air-flow ΔP, cm water Coarse	Air-flow ΔP, cm water Fine	Spot color and size in.		Base fuel and additive concn.[b]	WSIM
1	A	86	58	---	---	Dark		JP-5 AFA 16-lb	48
2	A	91	54	---	---	Dark	1/2	JP-5 AFA 16-lb	68
3	A	100	55	---	---	Light	1/8	JP-5 AFA 16-lb	49
4	A	94	49	2.6	19.2	Medium	3/8	JP-5 AFA 16-lb	60
5	A	90	49	2.2	16.0	Light	1/4	JP-5 AFA 16-lb	40
6	A	87	56	2.2	17.7	Light	1/4	JP-5 AFA 4-lb	56
7	A	90	56	2.4	18.0	Medium	3/8	JP-5, none	88
8	A	96	52	2.4	18.8	Medium	3/8	JP-5, none	96
9	B	87	45	2.5	19.7[c]	Medium	1/2	JP-5, none	98
10	B	80	40	2.1	18.3	Medium	1/2	JP-5, none	98
11	C	79	46	2.1	17.3	Medium	5/8	JP-5, none	100
12	C	98	39	2.2	16.9	Medium	1/2	JP-5, none	98
13	A	96	46	2.9	18.3	Medium	3/8	JP-5 AFA 4-lb	66
14	A	94	47	2.5	17.1	Medium	3/8	JP-5 Snt 4-lb	69
15	A	94	45	2.8	18.2	Dark	1/2	BTA[d], 0	99
16	A	102	52	2.6	19.4	Dark	1/4	BTA, 0.2 ppm	89
17	A	88	46	2.2	19.2	Medium	3/8	BTA, 0.4 ppm	87
18	A	90	55	2.7	19.0	Light	1/2	JP-5 Snt 4-lb	71
19	A	100	50	3.0	18.2	Dark	3/8	JP-5 Snt 4-lb	72
20	A	91	54	2.6	16.6	Lignt	1/4	BTA, 1.0 ppm	83
21	A	84	51	2.4	17.6	Light	5/16	BTA, 0.6 ppm	81
22	A	83	52	2.4	18.0	Light	1/4	BTA, 1.0 ppm	70
23	A	96	49	2.8	18.2	Medium	5/16	BTA, 0	99
24	A	84	49	2.6	18.6	Medium	3/8	JP-5 Snt 16-lb	72
25	A	104	46	3.0	18.0	Medium	3/8	JP-5 Snt 16-lb	60
26	A	104	47	2.6	17.3	Medium	5/16	JP-5 Snt 16-lb	57
27	A	77	44	2.2	17.0	Medium	3/8	BTA, 1.0 ppm	67
28	A	80	44	2.2	18.2	Light	3/8	BTA, 1.0 ppm	70
29	A	132	56	3.6[c]	17.8	Medium	1/4	BTA, 1.0 ppm	64
30	A	144	59	3.8[c]	20.0[c]	Medium	1/4	BTA, 1.0 ppm	64

a. A = SwRI, Bldg. 42-D; B = UDRI, Bldg. 70; C = AF-SAOQLA, Bldg. 70.
b. Concentrations shown as "lb" are in lb/1000 bbl.
c. Outside spec limits of 2.0-3.2 cm for coarse, 16.5-19.5 cm for fine.
d. Bayol/toluene/Aerosol OT reference blends.

TABLE 7. SEPARAMETER DATA (Cont'd)

Test no.	Disk source[a]	Disk wt., mg Coarse	Disk wt., mg Fine	Air-flow ΔP, cm water Coarse	Air-flow ΔP, cm water Fine	Spot color and size in.		Base fuel and additive concn.[b]	WSIM
31	A	96	53	2.7	18.5	Medium	3/8	JP-5 Snt 4-lb	63
32	A	85	54	2.0	18.8	Light	1/4	BTA[d], 1.0 ppm, 0.1% IPA	65
33	A	94	48	2.2	16.6	Light	1/4	BTA, 1.0 ppm, 0.2% IPA	60
34	A	100	53	3.0	19.0	Light	1/4	BTA, 1.0 ppm, 0.4% IPA	57
35	A	87	51	2.4	16.8	Medium	3/8	JP-5 Snt 16-lb	50
36	A	90	50	2.6	19.2	Medium	3/8	JP-5 Snt 16-lb	53
37	A	90	49	3.2	18.4	Medium	3/8	BT[e], 0.1% IPA	100
38	A	113	45	2.6	18.4	Medium	1/4	BT, 0.2% IPA	96
39	A	89	46	2.4	18.4	Light	3/8	BT, 0.4% IPA	94
40	A	92	38	3.5[c]	17.0	Dark	5/8	JP-5 Snt 16-lb	72
41	A	84	52	1.4[c]	17.6	Light	1/4	JP-5 RP 20-lb	44
42	A	92	51	2.4	18.2	Light	1/4	JP-5 RP 20-lb	35
43	A	88	52	2.2	18.8	Light	1/4	JP-5 RP 20-lb	33
44	A	56	50	3.0	17.4	Light	1/4	JP-5 RP 7-lb	39
45	A	87	51	2.3	19.5	Light	5/16	JP-5 RP 7-lb	49
46	A	93	52	2.6	17.2	Light	1/4	JP-5 AFA 16-lb	55
47	A	98	52	2.8	16.8	Light	1/4	JP-5 AFA 16-lb	66
48	A	98	46	3.0	17.6	Light	3/8	JP-5[f]	80
49	A	87	52	2.8	17.6	Light	3/8	JP-5 Tk 2	87
49A[g]	A	92	46	2.8	17.8	Medium	1/2	JP-5 Tk 2	90
50	A	101	45	3.0	16.6	Light	5/16	JP-5 Flush	85
51	A	94	47	2.5	17.7	Light	1/2	JP-5 B-21 Load 1	83
52	A	103	50	2.4	17.0	Light	1/2	JP-5 B-21 Load 2	81
53	A	116	48	2.8	19.4	Light	3/8	JP-5 B-21 Load 3	74
54	A	119	46	2.8	19.2	Medium	3/8	JP-5 B-21 Load 4	83
55	A	94	47	2.0	19.6[c]	Medium	5/16	JP-5 B-21 Tk 1	83
56	B	84	41	2.3	19.1	Light	5/8	JP-5 B-21 Tk 1	99

a. A = SwRI, Bldg. 42-D; B = UDRI, Bldg. 70; C = AF-SAOQLA, Bldg. 70.
b. Concentrations shown as "lb" are in lb/1000 bbl.
c. Outside spec limits of 2.0-3.2 cm for coarse, 16.5-19.5 cm for fine.
d. Bayol/toluene/Aerosol OT reference blends.
e. Bayol/toluene reference blend.
f. All uninhibited JP-5 in this group; samples taken while transferring new batch of fuel to Bldg. 42-D tanks.
g. Run on UDRI separometer by SwRI operator.

TABLE 7. SEPAROMETER DATA (Cont'd)

Test no.	Disk source[a]	Disk wt., mg Coarse	Disk wt., mg Fine	Air-flow ΔP, cm water Coarse	Air-flow ΔP, cm water Fine	Spot color and size in.		Base fuel and additive concn.[b]	WSIM
57	A	92	54	2.6	18.2	Medium	3/8	JP-5[c]B-21 Load 5	76
58	B	81	41	2.3	18.1	Medium	5/8	JP-5 B-21 Load 6	97
59	B	70	38	2.0	17.2	Medium	3/4	JP-5 B-21 Tk 1	98
60	B	88	45	2.3	18.2	Medium	1/2	JP-5 B-21 Tk 2	94
61	B	64	46	2.4	17.0	Dark	9/16	BTA[d], 0	100
62	B	70	50	2.4	17.6	Light	3/8	BTA, 0.2 ppm	91
63	B	67	48	2.8	17.6	Light	1/4	BTA, 0.4 ppm	87
64	B	70	45	3.2	18.6	Light	1/4	BTA, 1.0 ppm	64
65	B	91	49	2.7	18.5	Light	7/16	JP-5 Uni 9-lb	58
66	B	64	48	2.4	17.2	Light	3/8	JP-5 Uni 9-lb	60
67	B	72	45	2.4	17.6	None		JP-5 Uni 20-lb	32
68	B	86	48	3.0	18.0	Light	5/16	BTA, 0.2 ppm	94
69	B	72	53	3.0	18.2	Light	5/16	BTA, 0.27 ppm	92
70	B	61	47	2.6	17.2	Light	5/16	BTA, 0.33 ppm	87
71	B	75	46	3.0	18.8	Light	7/16	JP-5 Uni 20-lb	40
72	B	85	57	2.6	19.2	Medium	1/4	BTA, 0.6 ppm	77
73	B	82	47	2.5	19.2	Medium	1/4	BTA, 0.8 ppm	72
74	B	65	49	2.4	18.8	Light	3/8	BTA, 0	100
75	B	78	45	2.4	17.4	Light	3/8	BTA, 0.2 ppm	93
76	B	95	49	3.0	17.2	Light	1/4	BTA, 0.4 ppm	80
77	B	78	55	2.2	18.8	Light	1/4	BTA, 0.6 ppm	75
78	B	69	54	2.4	18.6	Light	1/4	BTA, 0.8 ppm	66
79	B	68	52	2.2	19.4	Light	1/4	BTA, 1.0 ppm	58
80	B	67	48	3.2	18.6	Light	1/2	JP-5 Uni 9-lb	73
81	B	66	49	2.8	17.4	Light	1/2	JP-5 Uni 9-lb	67
82	B	100	46	3.2	18.2	Light	3/8	JP-5 Uni 20-lb	33
83	B	89	50	2.6	18.4	Light	1/8	JP-5 Uni 20-lb	38

a. A = SwRI, Bldg. 42-D; B = UDRI, Bldg. 70; C = AF-SAOQLA, Bldg. 70.
b. Concentrations shown as "lb" are in lb/1000 bbl.
c. All uninhibited JP-5 in this group; samples taken while transfering new batch of fuel to Bldg 42-D storage tanks.
d. Bayol/toluene/Aerosol OT reference blends.

disks were rating lower, giving 88-96 WSIM in comparison with 98-100 WSIM with the other disks. The most conclusive demonstration of this difference was given during a fuel transfer operation, when the underground tanks at the fuel filtration facility (42-D) were being loaded with a new batch of fuel via refueler truck from Area B storage. In this series of WSIM tests, Runs 48-60, the higher ratings of the coalescer disks obtained from UDRI stock are quite evident by inspection. There did not appear to be any "machine bias," as evidenced by a single test by an SwRI operator on another separometer (Run 49A).

Statistical comparisons of the disk weights and air-flow pressure drops are given in Table 8. It will be noted that the SwRI disks were significantly heavier than the UDRI disks, but there were no significant differences in air-flow resistance. The differences in weights are highly significant; in each case, the probability of obtaining such a difference by chance is less than 0.1%.

Average WSIM values on various fuel-inhibitor formulations are shown in Table 9. The only set of data sufficient to establish a statistically significant difference is on the uninhibited JP-5 samples. There, the difference in means (84 for SwRI disks, 97 for UDRI disks) is highly significant, with only a 0.1% probability that the observed difference could have occurred by chance. Although the data on the blends of Aerosol OT in Bayol/toluene reference fluid do not provide any statistically significant comparisons, it is interesting to note that the difference between results with SwRI and UDRI disks is generally in the opposite direction from that shown on uninhibited JP-5. That is, with Bayol/toluene/Aerosol, the SwRI disks generally gave higher WSIM values, especially at higher concentrations of Aerosol OT.

Although the SwRI disks were clearly heavier than the UDRI disks and gave significantly lower WSIM values on uninhibited JP-5 fuel, one cannot conclude that variations in disk weight are solely or even mainly responsible for the poor precision of the separometer test. It is entirely possible that other properties of the fiberglass disks, not presently subject to control or even definition, have greater effects on performance of the disks in the separometer. To establish the degree of correlation between disk weight and WSIM results would require a large number of data-points, preferably obtained on fiberglass disks that can be identified as coming from the same original manufacturer's lot and from the same roll of fiberglass.

Before leaving the subject of coalescer disk weight, it may be useful to illustrate the extreme variations that contribute to the standard deviations cited previously. For the 81 fine disks and 81 coarse disks from UDRI and SwRI stock (Table 7), the numbers of disks in each weight range are as follows:

TABLE 8. STATISTICAL DATA FOR WSIM DISKS FROM THREE SOURCES

Disk source	Number of disks	Disk weight, mg		Air-flow ΔP, cm water	
		Mean	Std. dev.	Mean	Std. dev.
	Coarse disks				
UDRI	16	75.4	9.4	2.54	0.30
SwRI	53	94.5	13.0	2.62	0.41
SAOQLA	2	88.5	---	2.25	---
	Fine disks				
UDRI	16	45.2	4.1	18.06	0.86
SwRI	53	50.0	4.1	18.07	0.97
SAOQLA	2	42.5	---	17.35	---

TABLE 9. COMPARISON OF WSIM VALUES OBTAINED WITH DISKS FROM THREE SOURCES

Additive and concentration	Mean WSIM (and number of tests) with disks from SwRI	UDRI	SAOQLA
In uninhibited JP-5			
None	83.8 (12)	97.3 (6)	99.0 (2)
AFA-1, 4 lb/1000 bbl	61.0 (2)	---	---
AFA-1, 16 lb/1000 bbl	55.1 (7)	---	---
Santolene C, 4 lb/1000 bbl	70.7 (3)	---	---
Santolene C, 16 lb/1000 bbl	60.7 (6)	---	---
RP-2, 7 lb/1000 bbl	44.0 (2)	---	---
RP-2, 20 lb/1000 bbl	37.3 (3)	---	---
Unicor M, 9 lb/1000 bbl	---	64.5 (4)	---
Unicor M, 20 lb/1000 bbl	---	35.7 (4)	---
In Bayol/toluene reference blend			
None	99.0 (2)	100.0 (2)	---
0.2 ppm Aerosol OT	89 (1)	92.3 (3)	---
0.27 ppm Aerosol OT	---	92 (1)	---
0.33 ppm Aerosol OT	---	87 (1)	---
0.4 ppm Aerosol OT	87 (1)	83.5 (2)	---
0.6 ppm Aerosol OT	81 (1)	76.0 (2)	---
0.8 ppm Aerosol OT	---	69.0 (2)	---
1.0 ppm Aerosol OT	69.7 (6)	58 (1)	---
0.1% isopropanol	100 (1)	---	---
0.2% isopropanol	96 (1)	---	---
0.4% isopropanol	94 (1)	---	---
1.0 ppm Aerosol OT, 0.1% isopropanol	65 (1)	---	---
1.0 ppm Aerosol OT, 0.2% isopropanol	60 (1)	---	---
1.0 ppm Aerosol OT, 0.4% isopropanol	57 (1)	---	---

Number of fine disks		
Weight	SwRI	UDRI
35-39 mg	1	1
40-44 mg	2	3
45-49 mg	21	18
50-54 mg	22	5
55-59 mg	7	2

Number of coarse disks		
Weight	SwRI	UDRI
50-59 mg	1	
60-69 mg		9
70-79 mg	1	8
80-89 mg	14	9
90-99 mg	24	2
100-109 mg	8	1
110-119 mg	3	
120-129 mg		
130-139 mg	1	
140-149 mg	1	

From these data, it can be seen that the coarse disks exhibited almost a threefold variation in weight; this is quite clearly an unsatisfactory situation for a critical test component.

Work is being carried out through ASTM committees on improving this situation; such work will not be discussed here. The data presented in this report merely illustrate that significant variations in disk weight do occur, both lot-to-lot and within-lot, and that definite lot-to-lot differences in performance can be demonstrated.

c. Effect of Antistatic Additive on WSIM Value

A number of water separometer tests were performed in order to provide preliminary information about the effects of Shell ASA-3 antistatic additive on the water coalescence properties of fuels containing corrosion inhibitors. Results from tests involving combinations of Shell ASA-3 with Santolene C or duPont AFA-1, all in uninhibited JP-4 plus 0.1 vol. % FSII, are presented below:

Corrosion inhibitor and concn., lb/Mbbl	ASA-3, ppm by weight	WSIM values	Average WSIM
None	0	98 96 9[illegible] 99	98
	1	82 87	84
Santolene C, 4	0	90 96	93
	1	86 71 79	79
Santolene C, 8	0	93 95	94
	1	83 81	82
AFA-1, 4	0	79 96 100 [illegible] 95	93
	1	71 52 53 64 46	57
AFA-1, 8	0	90 90 93 87 9[illegible]	90
	1	82 52 68 46 [illegible]	62

The data indicate that the antistatic additive has a detrimental effect on the coalescence properties of JP-4. The presence of the antistatic additive is associated with significantly lower WSIM values for all five fuel-corrosion inhibitor combinations. There are no instances of fuel with antistatic additive having a WSIM value greater than that of the corresponding fuel without the additive. The data also suggest, but are insufficient to be conclusive, that the antistatic additive has a more detrimental effect on fuel containing AFA-1 than on fuel containing Santolene C. It is puzzling that WSIM values for fuels containing ASA-3 and 8 lb/Mbbl of corrosion inhibitor were slightly higher than the corresponding blends with 4 lb/Mbbl of corrosion inhibitor.

d. Correlation of WSIM and Esso Mini-Separometer Values

In order to compare water separometer results with those of an Esso Mini-Separometer, 27 pairs of tests were run on JP-5 fuel in a variety of conditions, such as, uninhibited, clay-treated, inhibited before running a single-element test, and inhibited after a single-element test. Results of these tests are given in Table 10. Statistical data are summarized below:

	WSIM	Min-S
Average value	77.6	74.4
Standard deviation	18.8	14.6

The averages and standard deviations are similar enough to indicate there is no significant difference in the two sets of data. Also, Student's test indicates that the probability of the observed difference of means occurring by chance is 50%. The WSIM values are plotted against Mini-Separometer values in Figure 6 . The values line up fairly well for the uninhibited fuel samples (circles) but are quite scattered for the inhibited fuel samples (triangles). This is not unexpected, in view of the known problems with poor repeatability of separometer results at values below 90 WSIM.

The data are insufficient for any firm conclusions on relative precision of the two methods. Qualitatively, it may be noted that the WSIM data for the inhibited fuel samples (all of the same nominal composition) showed a spread of 34 units, while the Min-S values showed a spread of only 21 units.

2. AEL FREE WATER DETECTOR

The AEL free water detector has been used as the primary method of analysis for free water content in rating single-element performance in this program. This device has been described in detail in a previous report*. It is applied to direct sampling from fuel lines, since serious losses and changes in free water content may occur in handling bottled samples.

* Johnston, R. K. and Morita, C. M., (Southwest Research Inst.) "Evaluation of a Detector for Free Water in Fuel," Air Force Aero Propulsion Lab. Tech. Rept. AFAPL-TR-66-39, April 1966.

TABLE 10. COMPARISON OF WSIM RESULTS WITH ESSO MINI-SEPAROMETER

Single-element test no.	Date	JP-5 fuel condition[a]	WSIM	Min-S
Tank #1	9 Sep 68	Raw, uninhibited	90	88
235	17 Sep 68	Clay-treated	96	90
235	18 Sep 68	Inhibited, pre-test	60	67
235	18 Sep 68	Post-test	61	64
236	18 Sep 68	Clay-treated	96	90
236	19 Sep 68	Inhibited, pre-test	54	70
236	19 Sep 68	Post-test	64	64
237	23 Sep 68	Clay-treated	92	90
237	23 Sep 68	Inhibited, pre-test	57	64
237	23 Sep 68	Post-test	70	64
Tank #1	24 Sep 68	Raw, uninhibited	90	87
238[b]	24 Sep 68	Clay-treated	93	85
238	24 Sep 68	Clay-treated	96	97
238	25 Sep 68	Inhibited, pre-test	72	71
238	25 Sep 68	Post-test	72	55
239	25 Sep 68	Clay-treated	94	95
239	26 Sep 68	Inhibited, pre-test	72	70
239	26 Sep 68	Post-test	54	58
240	26 Sep 68	Clay-treated	96	95
240	27 Sep 68	Inhibited, pre-test	81	65
240	27 Sep 68	Post-test	88	60
241	30 Sep 68	Clay-treated	97	92
241	1 Oct 68	Inhibited, pre-test	67	56
241	1 Oct 68	Post-test	62	50
242	1 Oct 68	Clay-treated	98	92
242	2 Oct 68	Inhibited, pre-test	63	65
242	2 Oct 68	Post-test	61	65

a. The inhibitors used for all tests were 20lb/Mbbl duPont RP-2 and 0.15 volume % FSII.

b. New elements were installed in the clay filter after this sample, and the new sample was analyzed.

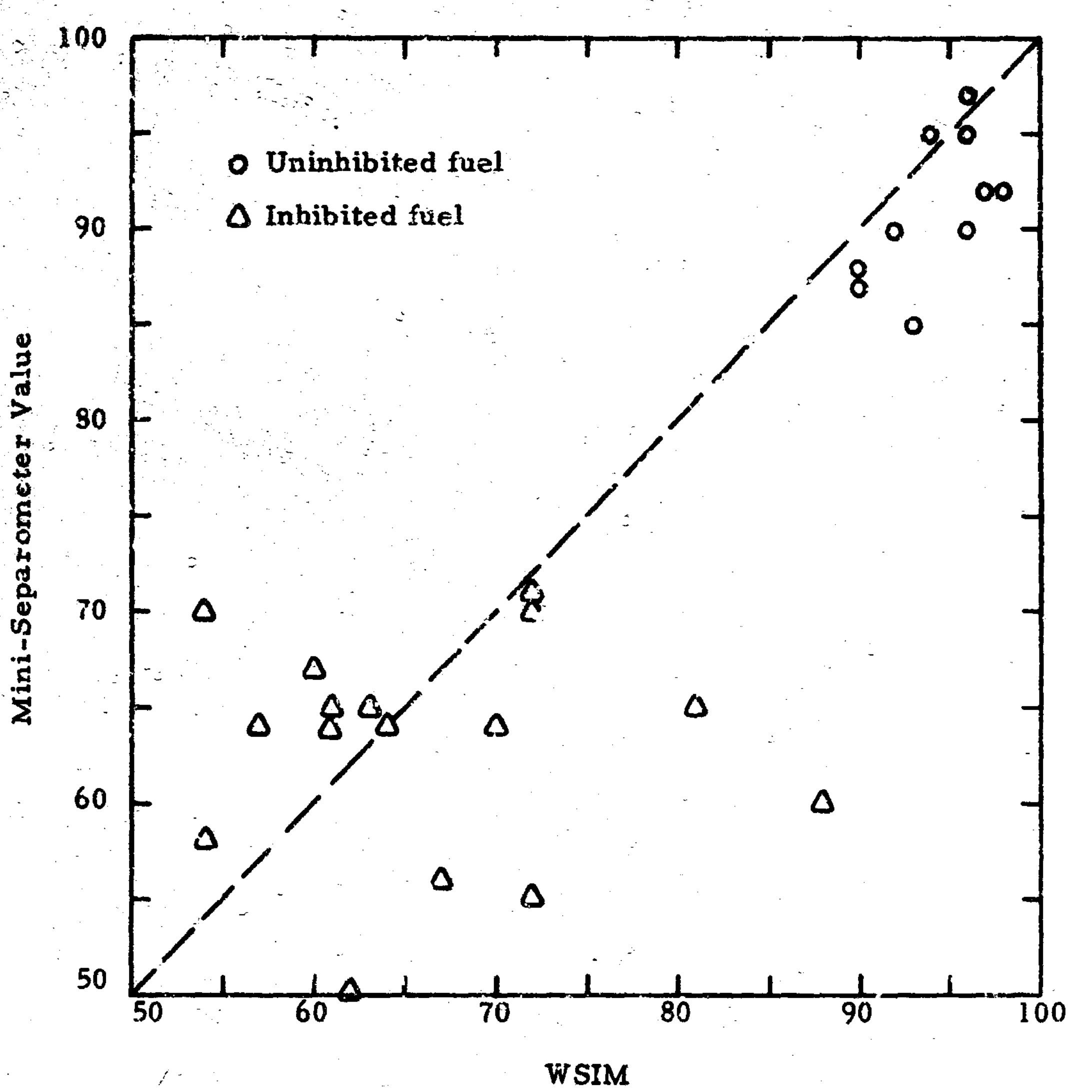


FIGURE 6. RELATION BETWEEN MINI-SEPAROMETER AND WSIM VALUES

Paper filter pads coated with a fluorescent dye, uranine, are used in this determination. Up until quite recently, all of the pads used in this program had been prepared by SwRI, since the commercially available pads were not considered sufficiently reliable. Difficulties in early commercial production, quality control, and packaging were apparently responsible.

A recent evaluation of a new lot of commercial pads has indicated that uniformity and quality have been improved substantially. The uranine contents (in milligrams) of 10 pads selected at random from this lot averaged 0.64 mg, with a standard deviation of 0.065 mg. This would indicate that, in a large lot of pads, 95% of them would have uranine contents within the range of 0.51-0.77 mg. This is well below the specification range of 0.80-0.85 mg required by MIL-D-81248(WP), but this deviation does not appear to interfere with proper functioning of the pads. It appears that the specification limits on uranine content may be unduly restrictive.

No extensive data on uranine contents of older commercial pads were obtained in this program. However, two pads checked in 1965 were found to have uranine contents of 1.48 and 1.68 mg.

The sensitivity and rating level of 16 pads selected at random from the recent commercial lot were checked on standard water-in-fuel dispersions prepared in a Waring Blendor. Independent ratings were made in random order by three individuals, without any foreknowledge of the expected free water contents. The following results were obtained:

Water added, mg/liter	Rating, mg/liter				
	A	B	C	Average	Average all pads
0	0	0	0	0	
0	0	0	0	0	
0	0	0	0	0	
0	0	0	0	0	
5	5-7	3-4	3-4	4.3	
5	2-3	2-3	2-3	2.5	
5	2-3	3-4	3-4	3.2	
5	2-3	2-3	2-3	2.5	3.1
10	9-10	7-8	7-8	8.2	
10	6-7	7-8	8-9	7.2	
10	6-7	6-8	7-8	7.0	
10	7-8	6-7	7-8	7.2	7.4
20	20	19-20	17-18	19.0	
20	17-18	17-18	17-18	17.5	
20	17-18	16-17	16-17	16.8	
20	16-17	14-15	15-16	15.5	17.2

In general, these commercially prepared pads tended to rate slightly low, but were acceptably close to the corresponding amounts of water added.

It was not possible to run a simultaneous comparison with pads prepared by SwRI, since these were in short supply and were needed for regular testing in the single-element program. It was not possible to prepare a new supply of pads, because of the high ambient humidity at the time and the lack of proper humidity-controlled working space. In general, based on past experience, the SwRI-prepared pads are expected to rate somewhat closer to the standards than did the commercial pads. Nevertheless, it is considered that the commercial pads are acceptable for regular use in the single-element program.

It might be pointed out that preparation of these pads in the laboratory requires careful technique, considerable time, suitable facilities, and low atmospheric humidity. Therefore, the use of commercially prepared pads is a considerable advantage in over-all performance of the program.

Still unresolved is the question of absolute accuracy of the AEL ratings, i.e., whether the numbers recorded really correspond to the true free water contents of the samples. This has been the subject of a considerable amount of controversy. One line of argument will run as follows: The original AEL fluroescence color standards were prepared from Waring-Blendor samples, hence are based on the assumption that these samples, really had free water contents corresponding to the amounts added. Losses of free water are possible during the sample blending and handling; water may transfer from the water droplets to the fuel and from the fuel to the atmosphere; also, water may "hang up" in the blender jar and in the filter funnel. If the blended samples used during the original standardization really contained less free water than the amount injected, then the absolute accuracy of the standards may be in serious error. According to this argument, the standard labeled "20 mg/liter" may really represent a fuel with only 5 or 10 mg/liter of free water; hence, ratings based on these standards would always be higher than the true values. We have made several attempts to resolve this question, but in each case there were problems in technique that have made it impossible to arrive at firm conclusions. Establishing an absolute standard of unquestionable accuracy is an extremely difficult task, because of the low concentrations involved, the fugitive nature of the water in the free and dissolved states, and the necessity for working with dynamic systems. Work is being continued along this line. At present, we can only conclude tentatively that AEL line-sample ratings, as obtained by the best technique available, may well be higher than the true free water contents. Until this question is fully resolved, it will be necessary to consider the AEL ratings as relative rather than absolute.

3. INTERFACIAL TENSION AS A MEASURE OF INHIBITOR CONTENT

In some of the earlier single-element tests on fuels containing corrosion in inhibitors, it had been observed that interfacial tensions on certain inhibitor blends were consistently much lower with tap water or synthetic injection water than with distilled water. Since the tap water and synthetic water are quite free of surfactants, as evidenced by their high surface tension values, it appeared probable that interaction between the fuel corrosion inhibitor and the inorganic salts in the water was having a significant effect on interfacial tension. The following values are typical of the results obtained:

Loop test no.	Inhibitor and concn., lb/Mbbl	Interfacial tension, dyn/cm, with water		
		Tap	Synth.	Dist.
63	None		38	40
38	Snt, 4	28		39
69	Snt, 4		35	41
39	Snt, 16	17		35
72	Snt, 16		22	36
42	Lub, 7	22		31
148	Lub, 20	17		27
26	AFA, 4	26		27
56	AFA, 4		19	21
100	AFA, 16		23	23

Very marked differences between the values with different waters are shown by the Santolene C and Lubrizol 541 blends, but practically no differences are shown by the AFA-1 blends. Other inhibitors that were tested were similar to the AFA-1, giving about the same IFT results regardless of the type of water used in the test.

Even though the tap water and synthetic water are only very slightly alkaline, it appears probable that the sodium ion present in the water can react at the interface with the organic acid that is the main constituent of the Lubrizol 541 and Santolene C, giving a marked reduction in interfacial tension. This theory would explain why other corrosion inhibitors, not containing a free organic acid, would not show a similar lowering in interfacial tension with the tap and synthetic waters.

Interfacial tension may be used as a rough measure of corrosion inhibitor content of fuels if the IFT depression produced by the inhibitor is

great enough. In the case of the Santolene C and similar inhibitors, which do not depress the standard IFT (distilled water) to any great extent, it appeared possible that the use of other types of water in the IFT test would give a useful measure of the fuel's inhibitor content. Such a method would be extremely valuable in this program, and would also be of considerable independent interest.

The first approach to this problem was a series of interfacial tension tests on Santolene C blends using sodium bicarbonate solution in comparison with distilled water. In contrast to earlier results with tap water and distilled water, the interfacial tension values were about 31-33 dyn/cm with either the bicarbonate solution or distilled water.

Subsequently, tests were run with sodium carbonate solution, which proved to have a much greater effect in depressing the interfacial tension. The solution consisted of 123 mg/liter of reagent-grade Na_2CO_3 in distilled water, giving the same ionic concentration (as bicarbonate) as is present in the standard Type B synthetic water, and about one-half to one-third the bicarbonate concentration that has been found in tap water from the Wright-Patterson AFB mains.

Data obtained on blends of Santolene C in uninhibited JP-5 are as follows:

	Interfacial tension, dyn/cm, with concentration of Santolene C as shown (lb/Mbbl)					
	0	2	4	8	12	16
Distilled water						
Series 1	44.2		42.3			32.2
	43.0		41.0			35.1
Carbonate solution						
Series 1	37.1		24.2	21.7	18.1	11.0
	36.8		30.5			12.6
			25.4			12.7
Series 2	41.0	38.4	34.0	24.8		20.4
				25.8		

The data obtained with carbonate solution are plotted in Figure 7. The Series 1 data, all obtained within six days, are plotted as circles. It will be observed that the correlation of inhibitor content with interfacial tension was reasonably good, all points falling within a band

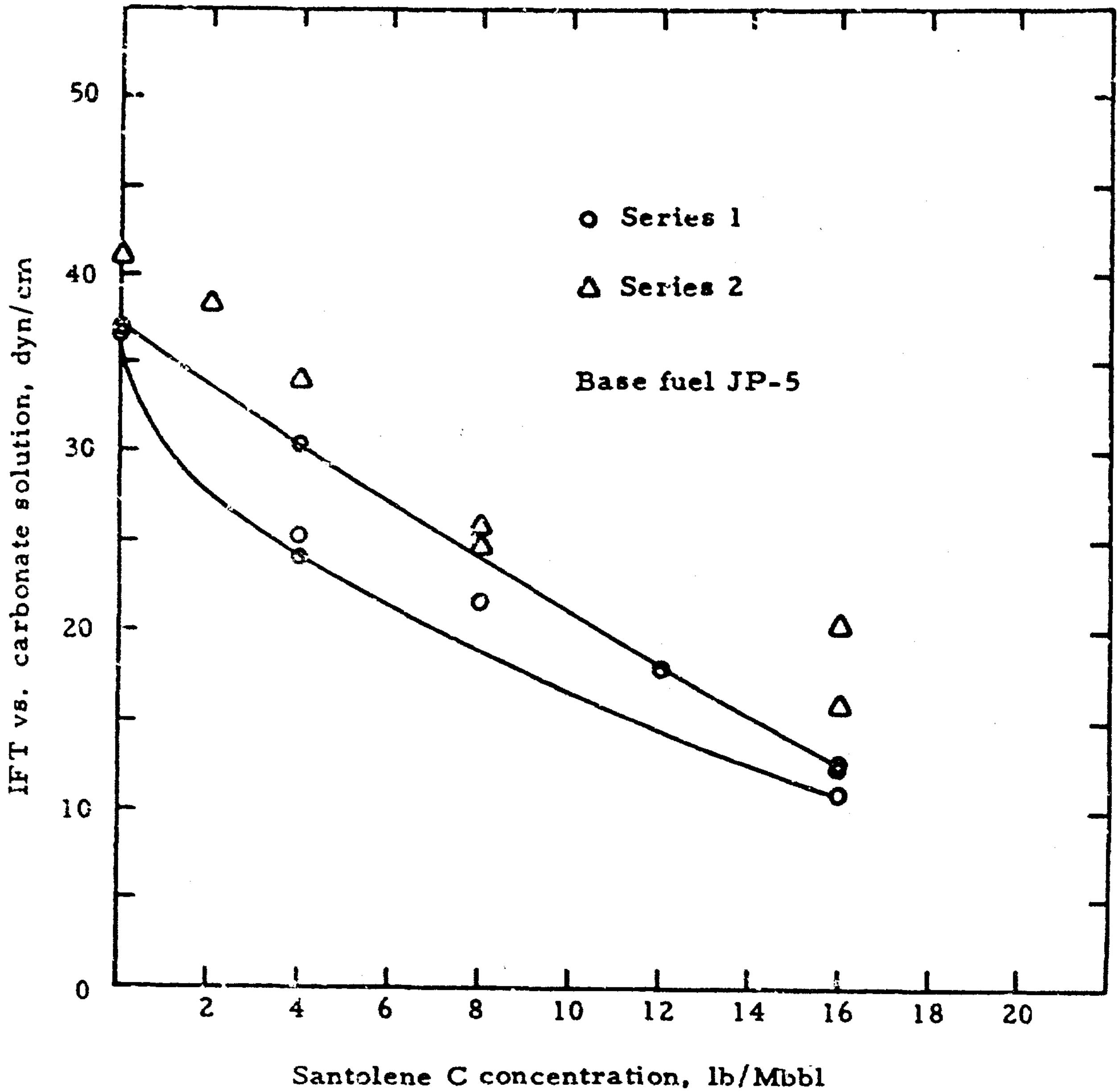


FIGURE 7. INTERFACIAL TENSION WITH SODIUM CARBONATE SOLUTION AS A FUNCTION OF CORROSION INHIBITOR CONCENTRATION

that is narrow enough to be of some value for estimating inhibitor concentrations. The Series 2 data (triangles) were obtained several weeks later; all of these data points fell outside the original Series 1 band. Considering the entire collection of data, one can see that there is far too much scatter to allow even rough estimates of inhibitor content from interfacial tension.

It is not at all clear why the later data deviated so markedly from the earlier data. One possibility is change in the base fuel, although all fuel was from the same batch. Another possibility is change in the conditions of running the interfacial tension test. Considerable difficulty has been encountered with this test because of lack of control of temperature and air movement within the laboratory. Replicate runs on the same sample often gave greater deviations than should be expected. Each of the interfacial tension values that were listed is the average of three to five readings on the same sample; in some cases, the variations were rather extreme. For example, the value of 24.2 dyn/cm for 4-lb Santolene C with carbonate solution (Series 1) resulted from the following data:

Individual instrument readings:	23.5, 24.6, 28.1, 23.5, 23.0
Average instrument reading:	24.5
Interfacial tension:	24.2

The precision statement of ASTM D 971-50 (applicable to oils rather than fuels) indicates that results obtained by the same operator with the same apparatus should not differ from the mean by more than 2% of the mean, which for the preceding case would be 0.5 dyn/cm. Actual deviations were up to 3.6 dyn/cm.

Although it is quite probable that the "correlation band" of inhibitor concentration vs. interfacial tension could be narrowed significantly by better test conditions, or possibly by the use of a different method for interfacial tension, it is probable that other factors, unrelated to the test itself, will prevent the establishment of any firm correlation. Tests on blends of inhibitor with a highly refined base stock would be necessary to establish whether time-dependent fuel-additive interactions or changes in the fuel itself are contributing greatly to the apparent lack of correlation. Although this question is of some theoretical interest, there does not appear to be enough promise of practical advantage to justify a full investigation.

4. SOLIDS RETAINED BY ELEMENTS IN FIELD SERVICE

Filter-separator elements in field service may be exposed to a wide variety of types and amounts of solid contaminants. Qualitatively, it is known that elements removed from service may be completely loaded with

solid material or may contain very little visible solid material. It was considered to be of interest to measure quantitatively the solids pickup on one specific set of filter-separator elements in field service. This was done for Separator Unit No. 3 in Pumphouse No. 2, Area C, Wright-Patterson AFB. This is a 300-gpm unit with 12 elements, each rated at 25 gpm. The elements in question were Bowser No. A-2063P, FSC 4330-788-8419.

Each of 12 new elements was weighed prior to installation. The elements were in service for 18 months. During this period, the eight filter-separators in the two Area C pumphouses (with a total of 96 elements) were handling an average of about 3 million gallons of fuel per month and were rotated on a scheduled basis. Thus, the average throughput per element during the 18-month period was about 560,000 gallons.

After removal from service, the elements were removed, taken to the laboratory, and dried to constant weight at room temperature with air flowing through the elements. No solvent rinses were used, since such treatment could remove organic solids that had been retained by the elements.

The initial weights and increases (in grams) were as follows:

1262	1427	1292	1354	1315	1262	1317	1261	1205	1231	1289	1396
12	6	22	25	13	26	18	19	1	19	22	17

The mean weight of this group of elements was 1309 g, and the standard deviation 56 g, or 4.3% of the mean. Variations of this order of magnitude are probably typical of within-batch variations for most filter-separator element production. In a batch of 69 elements of another design, it had been found that the standard deviation in weight was 7.8% of the mean.

The weight gains of the elements from the Area C pumphouse were all very small, mostly on the order of 15-25 g per element. This is very little in relation to the nominal dirt-holding capacity of the elements (250 g each) and to the amount of service the elements had seen. The greatest weight gain (26 g) corresponds to a solids removal of about 0.05 mg/gal from 560,000 gal of fuel, and the average weight gain (17 g) corresponds to a solids removal of about 0.03 mg/gal. It is evident that either the elements had been seeing extremely clean fuel, or else they did not stop much of the solids present in the fuel.

Very little solid material could be observed or recovered from the inside of the elements. The amount recovered from each element was only a few grams, far short of the 15-25 g weight gains. There was no

relation between amount of solids recovered and amount of weight gain during service. Most of the recovered solids consisted of black, magnetic particles, very likely black iron oxide. The particles ranged in size from about 25μ to 2 or 3 mm. A very careful examination of the material did not reveal the presence of any red iron oxide of normal rust particles. There were traces of sand, unidentified "dirt," and fragments of plastic, apparently derived from the end caps during element manufacture.

The difference between the weight gains and the amounts of recoverable solids can be attributed to pickup of very fine or gummy solids within the media. Each element was found to have a brown, wax-like material that coated completely the outside of the perforated-metal core between the core and the innermost, coarse fiberglass wrap. The layers of fine fiber, which in this particular element are initially white and soft, were found to be impregnated with a brown, waxy or gummy substance after the elements were removed from service. No serious attempt was made to identify this material. It was found to be essentially insoluble in common organic solvents.

Although the data from this examination are quite interesting, they obviously cannot be used for any generalizations. The data do suggest the possibility of more widespread use of such studies as a check on the quality of fuel handled by filter-separators, and hence on the efficiency of fuel handling and cleanup procedures in a base system ahead of the filter-separator in question. The technique is very simple, and all that would be required for a base to make such a study would be a balance, a supply of clean air for drying the elements (a small blower would suffice), and adequate records.

5. CLAY FILTER MEDIA MIGRATION

Prior to the use of the clay filter in treating fuel for single-element tests, a 125-minute operational check was made on the unit to establish whether or not clay migration might be a problem. Since the clay unit was installed downstream from the cleanup filter-separator, any clay released from the clay canisters would carry on through the system. The check was made in the Al/SS test loop using uninhibited JP-5 fuel, circulated at an average flow rate of 18.7 gpm. Fuel inlet temperature and pressure were 81-82°F and 70 psi. The data obtained, which are summarized in Table 11, indicate that no detectable migration of clay occurred. The high values obtained for solids contents of the initial samples are attributed to dirt introduced into the system during the plumbing modifications when the clay filter was installed. It will be noted that both the influent and effluent samples (to and from the clay filter) had high solids contents, the effluent being much the higher. Subsequent samples gave satisfactorily low solids contents.

TABLE 11. CLAY FILTER MEDIA MIGRATION STUDY

Time, min	Clay filter ΔP, psi	Totamitor[a] Infl.	Totamitor[a] Effl.	Solids mg/liter[b] Infl.	Solids mg/liter[b] Effl.	Influent fuel temperature, °F
0	-	0	0	0.60[c]	4.26[d]	81
5	1	0	0			81
10	1	0	0			81
15	1	0	0	0.42	0.06	81
20	2	0	0			81
25	2	0	0			81
30	2	0	0	0.16[e]	0.10[e]	81
35	2	0	0			81
40	1	0	0			81
45	2	0	0	0.10	0.21	81
50	1	0	0			81
55	1	0	0			81
60	1	0	0	0.03	---	81
65	1	1	0			81
70	1	1	0			81
75	2	1	0	0.07[f]	neg.	81
80	2	1	0			81
85	2	1	0			82
90	2	1	0	0.06	0.05	82
95	2	1	0			82
100	1	1	0			82
105	2	1	0	0.02	0.07	82
110	2	1	0			82
115	1	1	0			82
120	1	1	0	0.05	0.03	82
125	1	1	0			82

a. Totamitors are influent and effluent to F/S test section; in this test, the test section was bypassed, as the two Totamitors are equivalent.
b. Samples are influent and effluent to clay filter.
c. Metal filings present on test membrane.
d. Brown solid matter present on test membrane.
e. Samples colorless in appearance; earlier samples were yellow.
f. Millipore matched membranes were used from this point to end of test for solids analyses.

6. MEMBRANE FILTER COLOR RATINGS

In recent single-element tests, color ratings have been recorded for all filters used in solids determinations. The color standards are those under consideration by ASTM D-2 Tech J-X. These standards are not intended for quantitative prediction of solids contents, but can serve as a monitor to detect changes in the contamination level of a fuel handling system. In a test program such as the one reported herein, color ratings are very useful in on-the-spot interpretation of results, and may also be of value in detecting errors in gravimetric solids determinations, which may occur through arithmetical or weighing errors. So long as the test fuel and the test contaminants are the same in a series of tests, it would be expected that color ratings will give at least a rough correlation with solids contents.

Data from 10 single-element tests using fine or coarse AC dust are shown in Table 12 . Color ratings by different observers were in good agreement, in almost all cases within one unit. In only one case was there a greater spread (ratings of 5, 6, and 4 on one filter). The lineup with gravimetric solids contents was quite good. The four samples with 0.5 mg/liter solids content or higher gave color ratings of 4 to 6. All other samples had 0.2 mg/liter or lower solids contents, and gave color ratings of 0 to 2 in almost all cases. The average solids content corresponding to each color rating is plotted in Figure 8 . All points fall close to a straight line. Based on the smoothed data, and ignoring the single point for No. 3 color rating, the averages and probable ranges for the various color ratings are:

Color	mg/liter
0	0.03 (0.0-0.1)
1	0.06 (0.0-0.2)
2	0.13 (0.0-0.2)
3	0.3
4	0.6
5	1.2

These data are cited for purposes of illustration only. No statistical analysis has been made, in view of the limited number of data points. The color ratings are expected to be a valuable adjunct to subsequent work in single-element testing.

TABLE 12. COLOR RATINGS OF FILTERS IN SOLIDS DETERMINATIONS

Test no.[a] and test time, min	Solids, mg/liter	Color standard rating[b]		
225-5	0.13	1	1	1
-22	0.16	2	3	3
226-5	0.02	2	2	2
-22	0.76	4	4	5
-27	0.04	1	1	1
-39	-0.04	1	1	1
227-5	0.04	2	1	2
-20	0.53	4	4	5
-25	-0.08	1	1	2
228-5	-0.08	1	1	1
-21	1.23	5	6	4
-26	0.03	1	1	1
-35	0.11	1	1	1
229-5	-0.10	1	1	1
-10	0.09	1	1	1
-23	0.17	2	2	2

Test no.[a] and test time, min	Solids, mg/liter	Color standard rating[b]
230-5	0.14	1
-28	0.10	1
-33	-0.01	0
-46	-0.03	0
231-5	0.19	2
-32	0.20	1
-37	0.09	0
-50	0.09	0
232-5	0.10	1
-42	0.16	2
-47	0.03	0
-58	0.05	0
233-5	0.18	2
-39	0.50	4
-44	0.05	1
-55	0.03	0
234-5	0.12	1
-36	0.11	1
-41	0.04	0
-52	0.00	0

a. Tests 225-229 were run by Procedure 13-J with fine AC dust. Tests 230-234 were run by Procedure 13-A with coarse AC dust.

b. Solids determinations were run with Millipore 0.8μ, 37-mm diameter membrane filters. All color ratings were on the "B" color scale. For Tests 225-229, three ratings were made independently by three technicians. All fuel sample volumes were 3700-3900 ml.

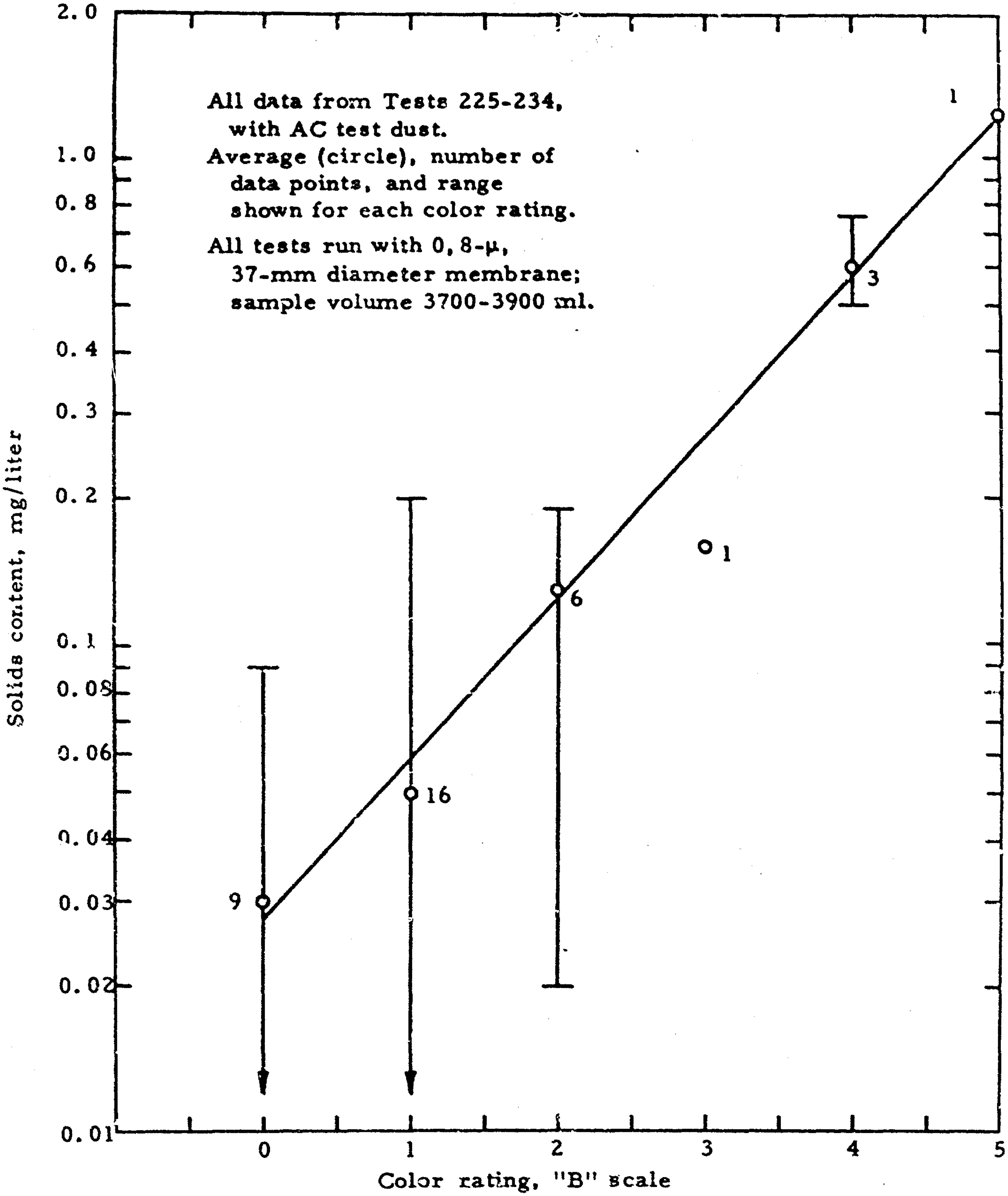


FIGURE 8. CORRELATION BETWEEN SOLIDS CONTENT AND FILTER COLOR RATING

VII. SUMMARY AND CONCLUSIONS

The single-element test program reported here has been concerned principally with the development of a procedure for comparing different fuel/inhibitor combinations as to relative ease of cleanup. A procedure identified as "13-A" has been developed for rating corrosion inhibitors. This procedure is somewhat similar to the standard MIL-F-8901A inhibited-fuel test procedure except that in Procedure 13-A the element is preloaded with test dust concurrently with small amounts of water injection, prior to testing the element's coalescing performance with larger amounts of water injection. This procedure is considered to be more realistic in terms of field conditions than is the 8901A procedure, where the element and test fuel are thoroughly water-washed prior to any injection of test dust. Based on a limited number of tests, corrosion inhibitor ratings by the two types of procedure are quite similar. Corrosion inhibitors qualified under MIL-I-25017 are divided into two distinct groups by either test procedure. No useful correlation could be demonstrated between WSIM values and performance in the single-element tests. In particular, two corrosion inhibitors gave satisfactory single-element results at WSIM values of 23-41.

Most of the test procedure development work was directed toward finding a more discriminating procedure, i. e., one that would provide a more severe test of corrosion inhibitors and that would spread out the ratings over a larger scale. This was accomplished by the use of a finer test dust (fine AC vs. coarse AC), but the resulting repeatability was so poor as to destroy the value of the modified procedure. Work is in progress to determine whether clay pretreatment of the base fuel will improve the repeatability situation. As of the present writing, it appears that no great improvement can be obtained. The earlier interpretation, that element-to-element variations are the principal source of test variability, still appears valid.

Another portion of the single-element test program was concerned with an evaluation of the effect of injection water properties on element performance. Water properties have very significant effects on fuel-water interfacial tension when the fuel contains certain types of corrosion inhibitors. However, no such effects on element performance were observed when the water pH, dissolved solids, and FSII content were varied over wide ranges.

A brief evaluation of the effects of the antistatic additive ASA-3 on element performance indicated that the ASA-3 had no measurable effect in uninhibited fuel or in fuel containing Santolene C, but did have a measurable adverse effect in fuel containing AFA-1 corrosion inhibitor.

Several fuel-soluble surfactants, sodium sulfonates and naphthenates, were found to have immediate and extreme effects in interfering with element performance, and the threshold concentrations for such effects varied widely among the different surfactants. One sodium sulfonate (425 mol. wt.) caused severe failures when present at a concentration of only 0.031 mg/liter of active ingredient. These failures would not have been predicted by the relatively high WSIM values of 76-82. In many cases, failures due to solids passage through the element occurred even when the surfactant concentration was insufficient to cause a coalescence failure.

A small-scale coalescence unit has been designed and is being used primarily in evaluation of different coalescence media. This unit is built around a homogenizer that provides dispersion of water in fuel in a single-pass operation. The test cell for the media is designed for loading of multiple media with independent control of density of each.

Problems with repeatability of separometer (WSIM) results during the period reported were found to arise principally from variations in the coalescer disks themselves. There were clearcut variations from batch to batch in disk weight and in disk performance. However, it was not possible to demonstrate any direct correlation between disk weight and disk performance, and in fact it is highly improbable that disk weight alone will govern disk performance. Further work along these general lines is being performed by an ASTM committee.

APPENDIX

SINGLE-ELEMENT TEST DATA

TABLE 1. LOOP TEST NO. 48 Date: 13 March 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Filtered tap water[a] injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.

(x) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119	None	vol. %
Corrosion inhibitor	None	lb/Mbbl

Fuel inlet temperature, °F	75 ± 2	Fuel throughput, gal	5287[b]
Test duration, min	233	Avg. flow rate, gpm	20.1

Actual element weight gain, g	794
Calculated dirt loading, g	972

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.26	0.02	0.11
	WSIM, dist. water	100		
	WSIM, inj. water	--		
	IFT, dist. water, dyn/cm	39.4		
	IFT, inj. water, dyn/cm	38.6		
	FSII content, vol. %	0.00		
Injection water	Solids, mg/liter			0.2[c]
	pH			7.4[c]
	ST, dyn/cm			69.9[c]
Coalesced water	pH			8.4[c]
	ST, dyn/cm			--
	FSII content, vol. %			--

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	2	2	1	1	1	1
Cleanup ΔP, psi	--	--	--	--	--	--	--
Throughput, gal	--	--	--	--	--	--	5287

(a) Filtered tap water used in this test only.
(b) Total throughput for 15 min pre-test and 248 min test period.
(c) Post-test samples.

TABLE 1. LOOP TEST NO. 48 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids, mg/liter	Free Water, mg/liter	Totamitor Reading
0	3.0	0.03		0
5	4.0	Neg	0	0
10	4.0	0.10	1-2	0
20	4.2	0.05	2-3	0
30	4.3	0.11	0-1	0
40	4.3	0.17	0-1	0
50	4.3	0.01	1-2	0
60	4.3	0.11	2-3	0
70	4.3	0.01	1-2	0
80	4.5	0.15	0-1	0
90	5.0	Neg	0-1	0
100	5.1	0.08	0-1	0
110	5.4	0.06	0	0
120	5.6	0.03	0	0
130	6.0	0.11	0	0
140	6.5	0.13	0	0
150	7.0	0.15	0-1	0
160	7.5	0.05	1-2	0
170	8.5	0.36	0	0
180	9.6	0.36	1-2	0
195	12.5	0.16	0	0
210	18.8	--	0	0
225	32.2	Neg	0	0
230	41.0	0.11	0	0
233	36.0			0

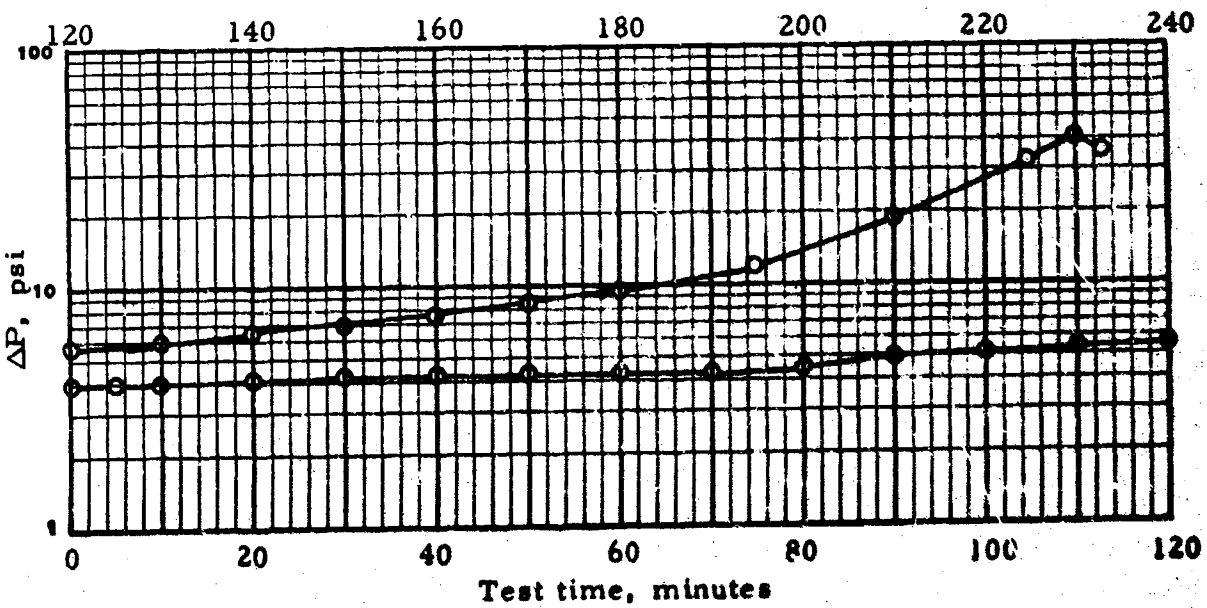


TABLE 2. LOOP TEST NO. 49 Date: 16 March 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.

(x) Fresh-fuel blend OR ( ) Fuel from previous test		
Fuel system icing inhibitor, Dow, Lot 08186119	None	vol. %
Corrosion inhibitor	None	lb/Mbbl

Fuel inlet temperature, °F	75 ± 2	Fuel throughput, gal	3377
Test duration, min	168	Avg. flow rate, gpm	20.1

Actual element weight gain, g	491
Calculated dirt loading, g	589

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.02	0.05	0.05
	WSIM, dist. water	100		
	WSIM, inj. water	--		
	IFT, dist. water, dyn/cm	42.4		
	IFT, inj. water, dyn/cm	34.7		
	FSII content, vol. %	0.00		
Injection water	Solids, mg/liter			0.04(a)
	pH			8.1(a)
	ST, dyn/cm			70.3(a)
Coalesced water	pH			8.1(a)
	ST, dyn/cm			--
	FSII content, vol. %			--

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	2	2	5	5	7	7	7
Cleanup ΔP, psi	0	0	0	0	0	0	0
Throughput, gal	207	812	1426	2034	2829	342[illegible]	3584

(a) Post-test samples.

TABLE 2. LOOP TEST NO. 49 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids, mg/liter	Free Water, mg/liter	Totamitor Reading
0[(a)]	4.6	0.49	0	100+[(a)]
5	4.6	0.04	--	0
10	4.7	0.07	0-1	0
20	5.0	0.16	1-2	0
30	5.0	0.01	0-1	0
40	5.4	0.10	1-2	0
50	5.4	0.08	1-2	0
60	5.7	1.17[(b)]	4-5	0
70	5.4	0.15	4-5	0
80	5.9	0.09	4-5	0
90	6.5	0.06	3-5	0
100	7.9	0.10	2-4	0
110	9.2	0.15	4-6	0
120	10.8	0.02	5-7	0
130	12.3	0.11	2-4	0
140	15.0	0.02	1-3	0
150	20.2	0.10	0-1	0
160	31.5	0.09	1-2	0
163	40.5	0.10	10-12	0
168	39.8			

(a) Test housing bypass line open during first 2 min of test. Between 5 and 20 min, about 30 short-term peaks appeared on Totamitor chart, maximum reading (peak height) 30.

(b) Probable weighing error; filter appeared clean.

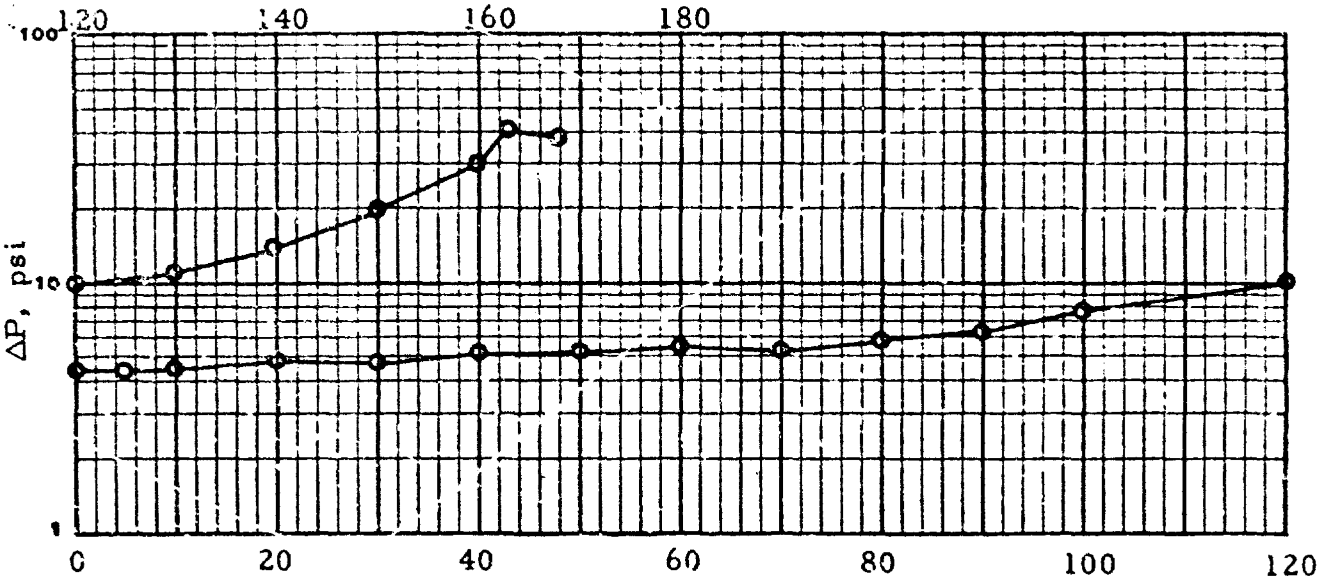


TABLE 3. LOOP TEST NO. 50 Date: 20 March 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.

( ) Fresh-fuel blend OR (x) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119	0.15	vol. %
Corrosion inhibitor	None	lb/Mbbl

Fuel inlet temperature, °F	75 ± 3	Fuel throughput, gal	4377
Test duration, min	220	Avg. flow rate, gpm	19.9

Actual element weight gain, g	641
Calculated dirt loading, g	904

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	--	0.03	Neg
	WSIM, dist. water	100		--
	WSIM, inj. water	--		100
	IFT, dist. water, dyn/cm	--		--
	IFT, inj. water, dyn/cm	--		28.8
	FSII content, vol. %	0.14		0.02
Injection water	Solids, mg/liter		1.3	--
	pH		8.2	8.1
	ST, dyn/cm		58.4	43.3
Coalesced water	pH		8.2	8.4
	ST, dyn/cm		53.9	61.4
	FSII content, vol. %		5.5	1.7

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	2	2	2	2	2	2	2
Cleanup ΔP, psi	0	0	0	0	0	0	0
Throughput, gal	356	943	1540	2236	2939	3536	4733

TABLE 3. LOOP TEST NO. 50 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free Water, mg/liter	Totamitor Reading
0	3.5			0
10	4.0			0 (30-sec peak of 2 at 11 min)
20	4.0			0
30	4.0	0.04	3-4	0 (Minor "blips" at 21 and 35 min)
40	4.0			0
50	4.2			0
60	4.0			0
70	4.4			0
80	4.6			0
90	4.8			0
95	5.0	0.01	1-2	0
100	5.2			0
110	5.4			0
120	5.8			0
130	6.2	Neg.	2-3	0
140	6.8			0
150	7.6			0
160	8.5			0
170	9.6			0
180	11.4			0
190	14.4			0
200	18.0			0
203	20.0	0.02	2-3	0
210	26.0			0
218	40.0	0.04	2-3	0
220	43.2			

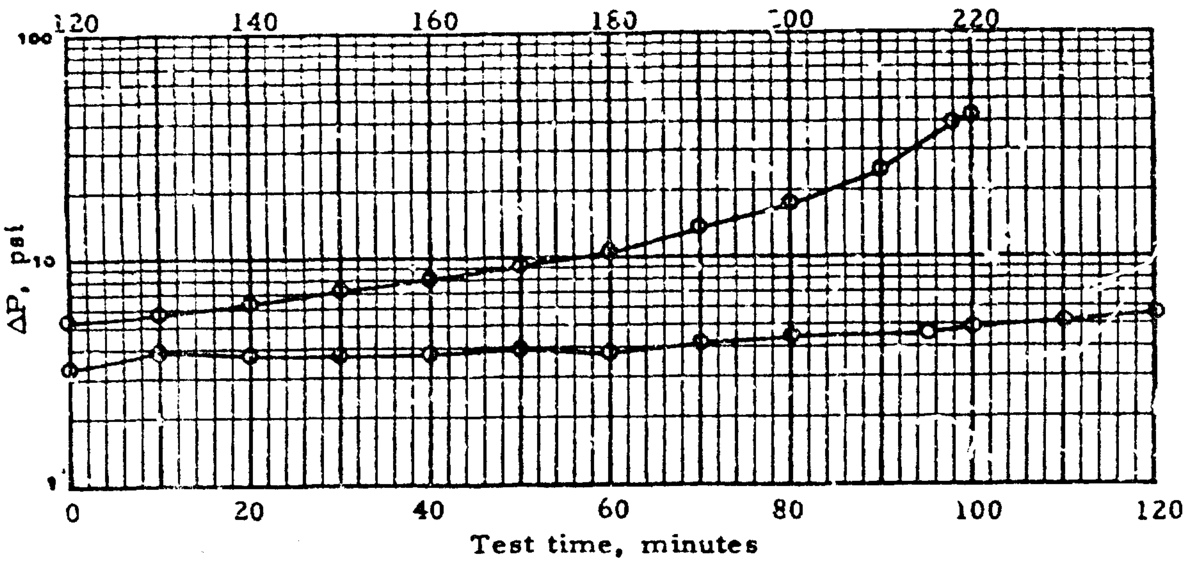


TABLE 4. LOOP TEST NO. 51 Date: 21 March 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 236).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.
( ) Fresh-fuel blend OR (x) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119	0.15	vol. %
Corrosion inhibitor	None	lb/Mbbl

Fuel inlet temperature, °F	75 ± 1	Fuel throughput, gal	3792
Test duration, min	190	Avg. flow rate, gpm	20.0

Actual element weight gain, g	565
Calculated dirt loading, g	729

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	--	Neg	0.02
	WSIM, dist. water	98		--
	WSIM, inj. water	98		100
	IFT, dist. water, dyn/cm	40.1		--
	IFT, inj. water, dyn/cm	39.6		37.6
	FSII content, vol. %	0.14		0.02
Injection water	Solids, mg/liter		0.4	--
	pH		8.0	8.1
	ST, dyn/cm		61.9	59.6
Coalesced water	pH		8.2	8.3
	ST, dyn/cm		56.6	56.1
	FSII content, vol. %		4.5	1.7

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	2	6	6	6	7	7	7
Cleanup ΔP, psi	0	0	0	0	0	0	0
Throughput, gal	307	895	1488	2190	2898	3495	4099

TABLE 4. LOOP TEST NO. 51 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids, mg/liter	Free Water, mg/liter	Totamitor Reading
0	3.0			0
10	4.3			0
20	4.4			0
30	4.5	0.03	0-1	0
40	4.6			0
50	4.6			0
60	4.7			0
70	4.9			0
80	5.2			0
90	5.5			0
95	5.7	0.02	0-1	0
100	5.9			0
110	6.3			0
120	6.8			0
130	7.7	Neg	0-1	0
140	8.8			0
150	10.4			0
160	12.5			0
170	17.0			0
174	20.0	0.01	3-5	0
180	25.1			0
188	40.0	0.05	6-8	0
190	36.0			

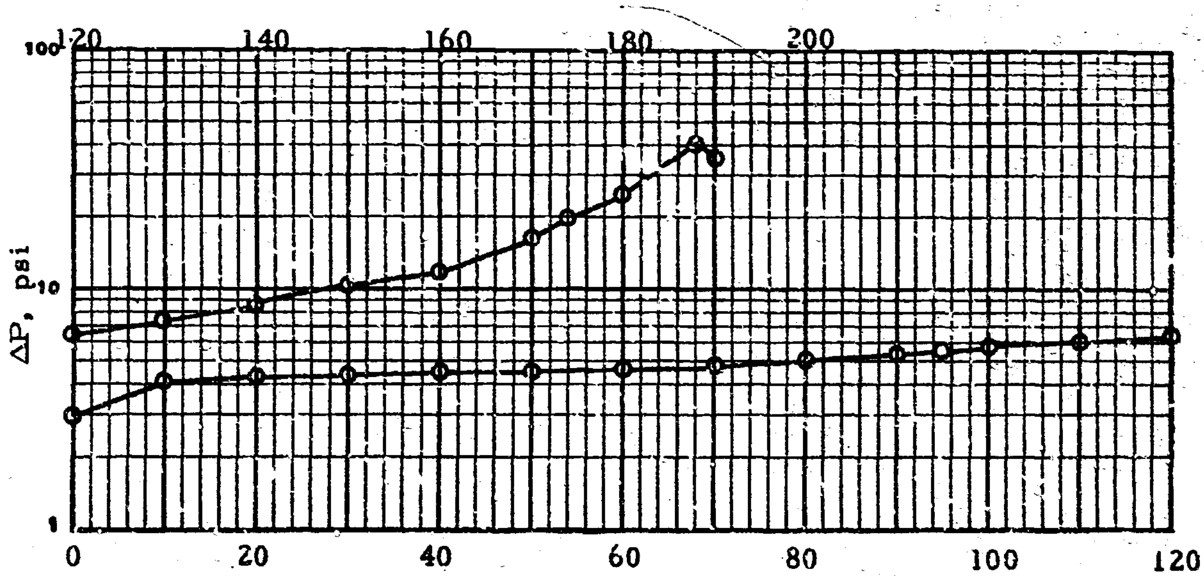


TABLE 5. LOOP TEST NO. 52 Date: 22 March 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 28[illegible]).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.

( ) Fresh-fuel blend OR (x) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119	0.15	vol. %
Corrosion inhibitor Santolene C, Lot NH04-006	4	lb/Mbbl

Fuel inlet temperature, °F	75 ± 1	Fuel throughput, gal	2747
Test duration, min	137	Avg. flow rate, gpm	20.0

Actual element weight gain, g	349
Calculated dirt loading, g	430

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.83	0.60	0.08
	WSIM, dist. water	9.1		--
	WSIM, inj. water	85		79
	IFT, dist. water, dyn/cm	33.2		--
	IFT, inj. water, dyn/cm	18.5		22.9
	FSII content, vol. %	0.14		0.03
Injection water	Solids, mg/liter		0.1	--
	pH		8.2	8.1
	ST, dyn/cm		69.5	69.8
Coalesced water	pH		8.2	8.2
	ST, dyn/cm		35.8	53.5
	FSII content, vol. %		4.6	2.1

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	2	2	2	1	1		1
Cleanup ΔP, psi	0	0	0	0	0		0
Throughput, gal	306	913	1521	2212	2889		3053

TABLE 5. LOOP TEST NO. 52 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids, mg/liter	Free Water, mg/liter	Totamitor Reading
0	3.0			0
10	3.8			0
20	4.1			0
30	4.2	0.04	2-4	0
40	4.1			0
50	4.1			0
60	4.1			0
70	4.2			0
80	4.5			0
90	5.2			0
95	6.0	0.03	0-1	0
100	7.5			0
110	11.2			0
120	17.3			0
122	20.0	0.00	0-1	0
130	31.0	0.07	0-1	0
135	40.0	Neg	0-1	0
137	29.3			0

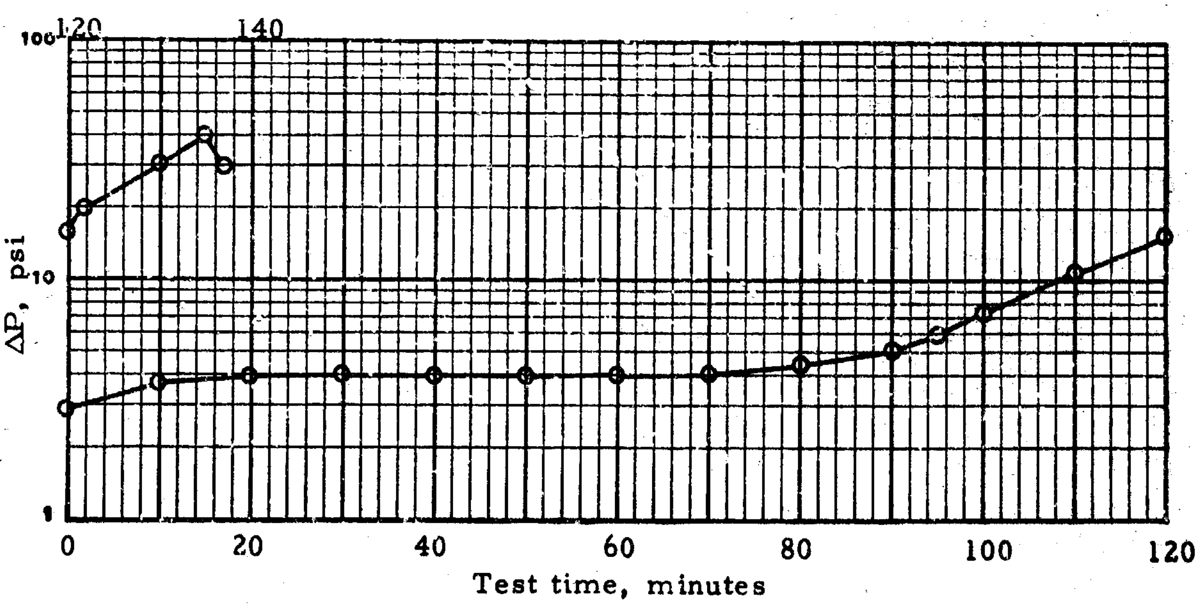


TABLE 6. LOOP TEST NO. 53 Date: 23 March 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.
( ) Fresh-fuel blend OR (x) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119	0.15	vol. %
Corrosion inhibitor, Santolene C, Lot NH04-006	4	lb/Mbbl

Fuel inlet temperature, °F	75 ± 1	Fuel throughput, gal	2911
Test duration, min	146	Avg. flow rate, gpm	19.9

Actual element weight gain, g 399
Calculated dirt loading, g 481

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.09	0.04	0.15
	WSIM, dist. water	95		--
	WSIM, inj. water	75		68
	IFT, dist. water, dyn/cm	35.8		--
	IFT, inj. water, dyn/cm	25.1		28.2
	FSII content, vol. %	0.15		0.02
Injection water	Solids, mg/liter		0.0	--
	pH		8.0	8.0
	ST, dyn/cm		70.3	70.2
Coalesced water	pH		8.2	8.2
	ST, dyn/cm		56.4	56.8
	FSII content, vol. %		5.9	1.7

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	3	3	3	3	3		3
Cleanup ΔP, psi	0	0	0	0	0		0
Throughput, gal	306	898	1500	2199	2898		3217

TABLE 6. LOOP TEST NO. 53 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids, mg/liter	Free Water, mg/liter	Totamitor Reading
0	2.8			0
10	3.7			0
20	3.7			0
30	3.8	0.03	0-1	0
40	4.0			0
50	4.0			0
60	4.1			0
70	4.2			0
80	4.5			0
90	5.0			0
95	5.4	0.07	5-7	0
100	6.4			0
110	8.9			0
120	11.6			0
130	18.2	0.12	4-5	0
132	20.0	0.10	4-5	0
140	32.3			0
144	40.0	0.05	8-10	0
146	33.0			0

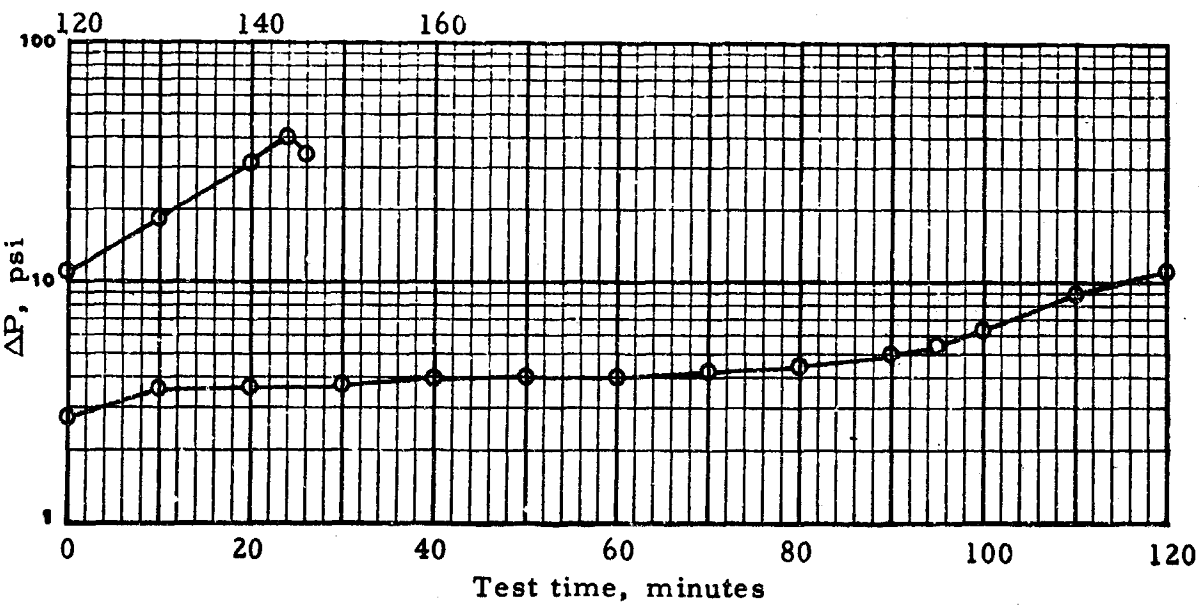


TABLE 7. LOOP TEST NO. 54 Date: 24 March 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel: uninhibited JP-4 Batch 14 plus additives as shown.
( ) Fresh-fuel blend OR (x) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119	0.15	vol. %
Corrosion inhibitor, Santolene C, Lot NH04-006	16	lb/Mbbl

Fuel inlet temperature, °F	75 ± 2	Fuel throughput, gal	1960
Test duration, min	99	Avg. flow rate, gpm	19.8

Actual element weight gain, g	235
Calculated dirt loading, g	235

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.01	0.25	0.03
	WSIM, dist. water	80		--
	WSIM, inj. water	88		75
	IFT, dist. water, dyn/cm	32.1		--
	IFT, inj. water, dyn/cm	11.9		12.7
	FSII content, vol. %	0.12		0.02
Injection water	Solids, mg/liter		0.2	--
	pH		8.0	8.0
	ST, dyn/cm		70.1	70.0
Coalesced water	pH		8.0	8.0
	ST, dyn/cm		54.0	54.8
	FSII content, vol. %		5.7	1.6

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	1	1	1	1			1
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	366	962	1558	2238			2326

TABLE 7. LOOP TEST NO. 54 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids, mg/liter	Free Water, mg/liter	Totamitor Reading
0	3.3			0
10	3.8			0
20	3.9			0
30	4.0	Neg	6-8	0
40	4.1			0
50	4.0			0
55	4.0			0
(a)				
60	4.0			0
70	4.5			0
80	7.1			0
88	20.0	0.04	8-9	0
90	27.0			0
94	40.0	0.04	8-9	0
96	45.0			0
99	38.0			0

(a) Solids injection started at 55 min, i.e., 5 min before regular time.

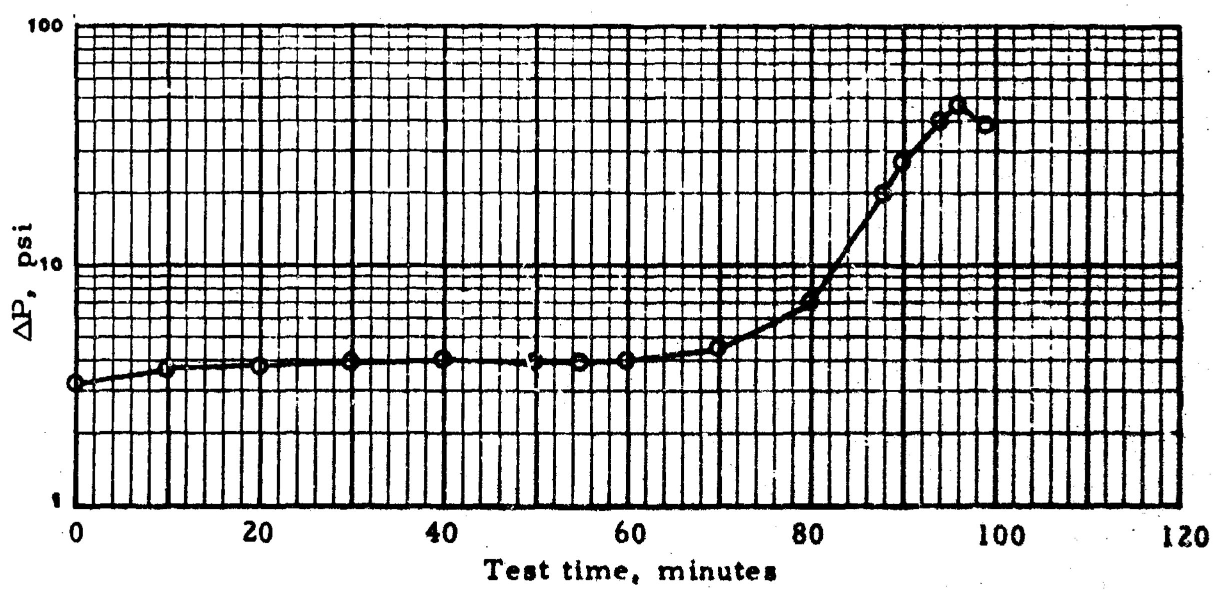


TABLE 8. LOOP TEST NO. 55 Date: 27 March 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.
( ) Fresh-fuel blend OR (x) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119	0.15	vol. %
Corrosion inhibitor, Santolene C, Lot NH04-006	16	lb/Mbbl

Fuel inlet temperature, °F	75 ± 2	Fuel throughput, gal	2429
Test duration, min	122	Avg. flow rate, gpm	19.9

Actual element weight gain, g	335
Calculated dirt loading, g	338

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.07	0.06	0.01
	WSIM, dist. water	72		--
	WSIM, inj. water	74		75
	IFT, dist. water, dyn/cm	28.5		--
	IFT, inj. water, dyn/cm	14.1		16.1
	FSII content, vol. %	0.12		0.01
Injection water	Solids, mg/liter		0.2	--
	pH		8.1	8.0
	ST, dyn/cm		65.6	63.3
Coalesced water	pH		8.1	8.0
	ST, dyn/cm		53.0	53.4
	FSII content, vol. %		3.0	1.0

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	1	1	1	1			1
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	303	904	1498	2200			2732

TABLE 8. LOOP TEST NO. 55 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids, mg/liter	Free Water, mg/liter	Totamitor Reading
0	3.7			0
10	4.4			0
20	4.7			0
30	4.6	0.04	0-2	0
40	4.5			0
50	4.5			0
60	4.5			0
70	4.7			0
80	5.1			0
90	5.6			0
95	6.3	0.02	1-3	0
100	8.9			0
110	17.5			0
111	20.0	0.07	2-4	0
118	40.0	0.04	4-6	0
122	35.0			0

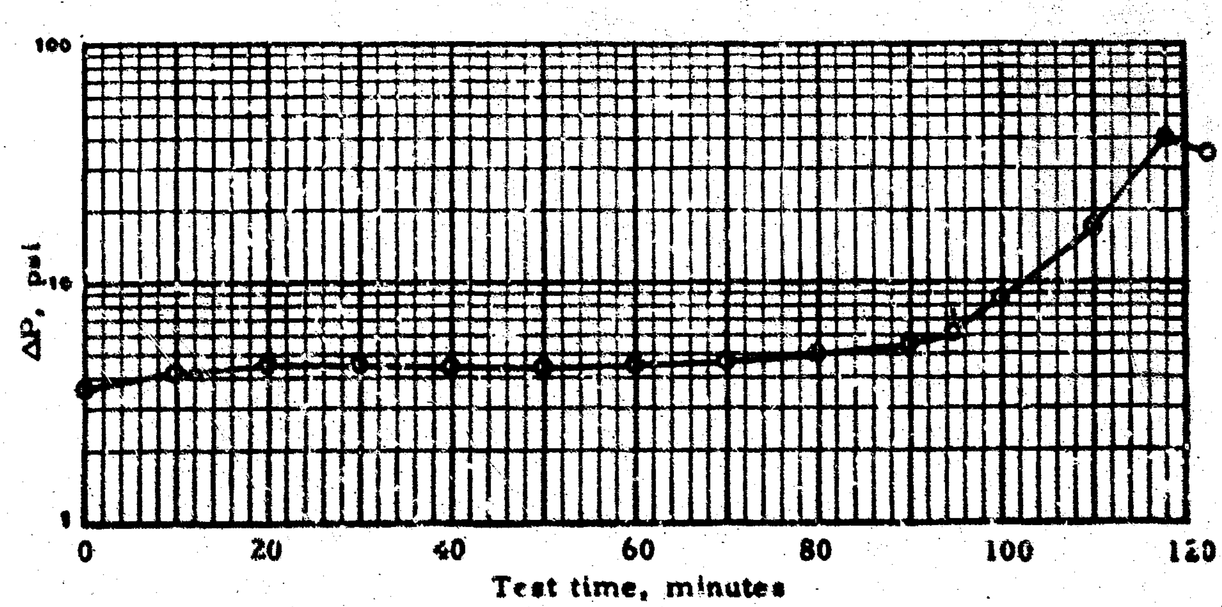


TABLE 9. LOOP TEST NO. 56 — Date: 28 March 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.
(x) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119	0.15	vol. %
Corrosion inhibitor, AFA-1, Lot 37	4	lb/Mbbl

Fuel inlet temperature, °F	75 ± 2	Fuel throughput, gal	3714
Test duration, min	186	Avg. flow rate, gpm	20.0

Actual element weight gain, g	622
Calculated dirt loading, g	709

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.10	0.02	0.01
	WSIM, dist. water	94		--
	WSIM, inj. water	86		84
	IFT, dist. water, dyn/cm	21.2		--
	IFT, inj. water, dyn/cm	18.8		21.6
	FSII content, vol. %	0.16		0.02
Injection water	Solids, mg/liter		0.1	--
	pH		8.0	8.1
	ST, dyn/cm		63.8	67.9
Coalesced water	pH		7.6	7.9
	ST, dyn/cm		38.6	41.0
	FSII content, vol. %		5.5	1.4

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	2	3	3	3	3	3	3
Cleanup ΔP, psi	0	0	0	0	0	0	0
Throughput, gal	306	864	1501	2199	2901	3499	4020

TABLE 9. LOOP TEST NO. 56 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids, mg/liter	Effluent Fuel Quality: Free Water, mg/liter	Totamitor Reading
0	3.2			0
10	4.0			0
20	4.4			0
30	4.5	0.02	2-4	0
40	5.1			0
50	5.6			0
60	5.7			0
70	5.1			0
80	5.6			0
90	6.2			0
95	6.6	0.04	2-4	0
100	7.1			0
110	8.2			0
120	9.5			0
130	11.0	0.05	7-9	0
140	12.3			0
150	14.7			0
160	18.5			0
162	20.0	0.07	10-12	0
170	25.0			0
180	35.0			0
184	40.0	0.02	12-14	0
186	36.0			0

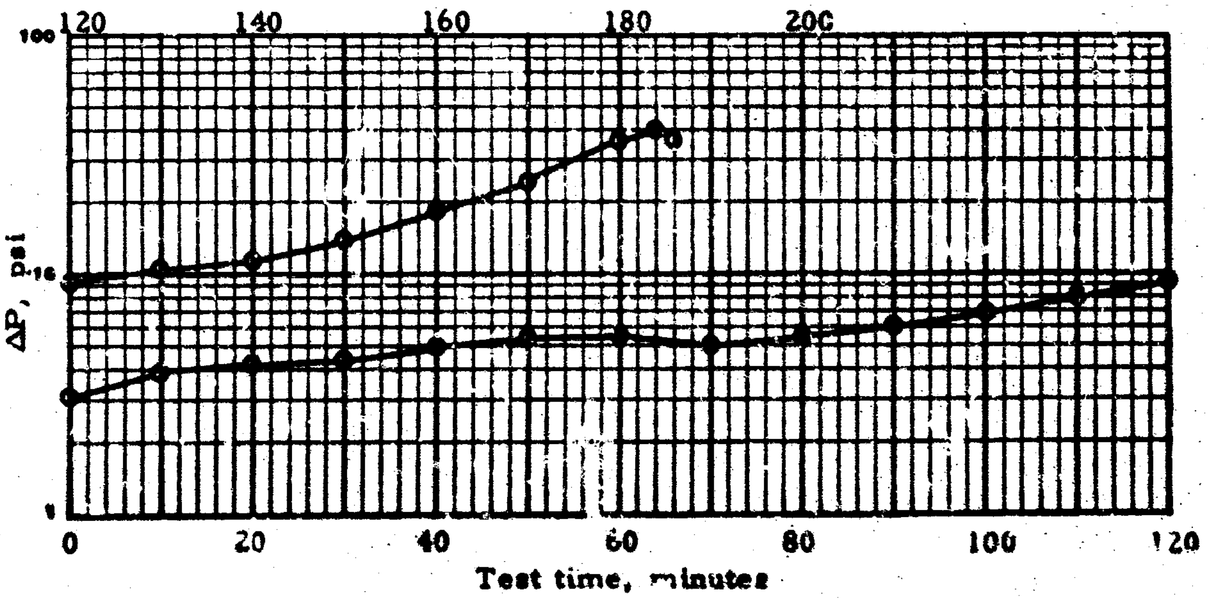


TABLE 10. LOOP TEST NO. 57 Date: 30 March 1967

Al/SS loop with 8" I. D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.
(x) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119	0.15	vol. %
Corrosion inhibitor, Tolad 244, Lot 47-12	5.5	lb/Mbbl

Fuel inlet temperature, °F	75	Fuel throughput, gal	84
Test duration, min	4[a]	Avg. flow rate, gpm	21

Actual element weight gain, g
Calculated dirt loading, g

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter			
	WSIM, dist. water			
	WSIM, inj. water			
	IFT, dist. water, dyn/cm			
	IFT, inj. water, dyn/cm			
	FSII content, vol. %		(a)	
Injection water	Solids, mg/liter			
	pH			
	ST, dyn/cm			
Coalesced water	pH			
	ST, dyn/cm			
	FSII content, vol. %			

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	2						2
Cleanup ΔP, psi	0						0
Throughput, gal	84						84

(a) Test terminated after 4 min of pre-test time because of excessive pressure drop. No water or solid contaminant was injected.

TABLE 10. LOOP TEST NO. 57 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids, mg/liter	Free Water, mg/liter	Totamitor Reading
(Pre-test)				
0				
4	45.0			

Test terminated after 4 min of pre-test period with fuel flow only.

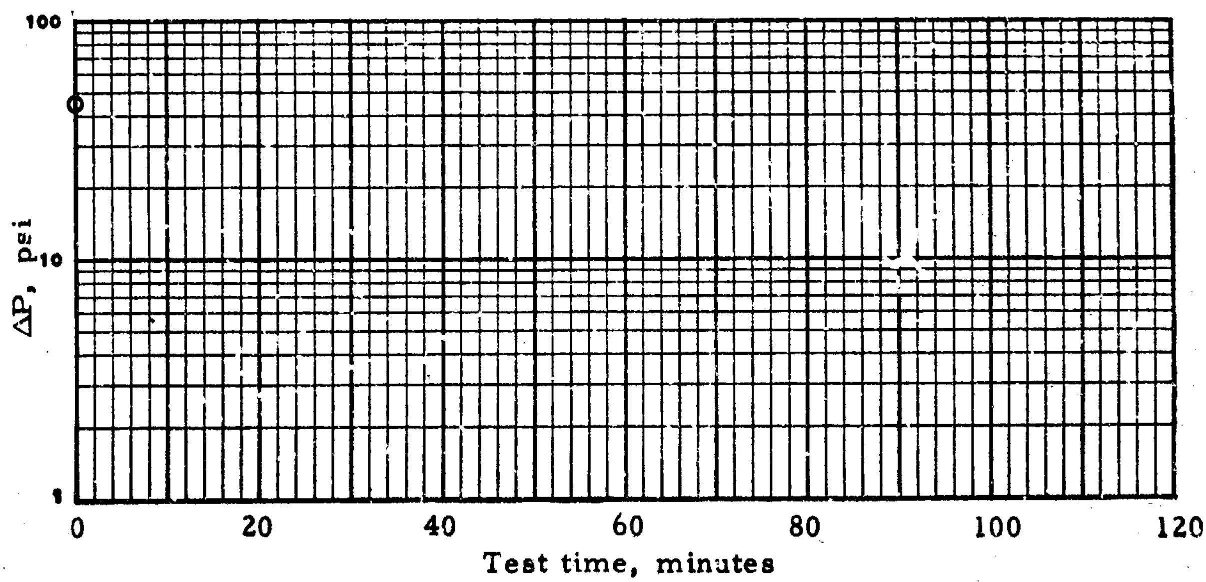


TABLE 11. LOOP TEST NO. 58 Date: 30 March 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.
(x) Fresh-fuel blend[a] OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119	0.15	vol. %
Corrosion inhibitor, Tolad 244, Lot 47-12	5.5	lb/Mbbl

Fuel inlet temperature, °F	75 ± 3	Fuel throughput, gal	2909
Test duration, min	147	Avg. flow rate, gpm	19.8

Actual element weight gain, g	448
Calculated dirt loading, g	480

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.10	0.11	0.04
	WSIM, dist. water	88		--
	WSIM, inj. water	74		35
	IFT, dist. water, dyn/cm	27.6		--
	IFT, inj. water, dyn/cm	14.0		15.1
	FSII content, vol. %	0.12		0.01
Injection water	Solids, mg/liter		0.2	--
	pH		8.1	8.1
	ST, dyn/cm		69.9	71.8
Coalesced water	pH		7.9	8.0
	ST, dyn/cm		45.0	48.5
	FSII content, vol. %		5.6	1.4

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	2	2	2	2	1		2
Cleanup ΔP, psi	0	0	0	0	0		0
Throughput, gal	321	902	1499	2202	2870		3230

(a) Fuel blend, which had been used in aborted test (No. 57) without any water or solids injection, is still considered "fresh."

TABLE 11. LOOP TEST NO. 58 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free Water, mg/liter	Totamitor Reading
0	3.1			0
10	3.8			0
20	3.9			0
30	4.1	0.07	4-6	0
40	4.2			0
50	4.1			0
60	4.1			0
70	4.4			1
80	5.0			2
90	5.1			2
95	6.9	0.10	6-8	2
100	8.0			1
110	10.2			1
120	13.8			2
128	20.0	0.12	12-14	2
140	32.5			2
144	40.0	0.08	10-12	2
147				0

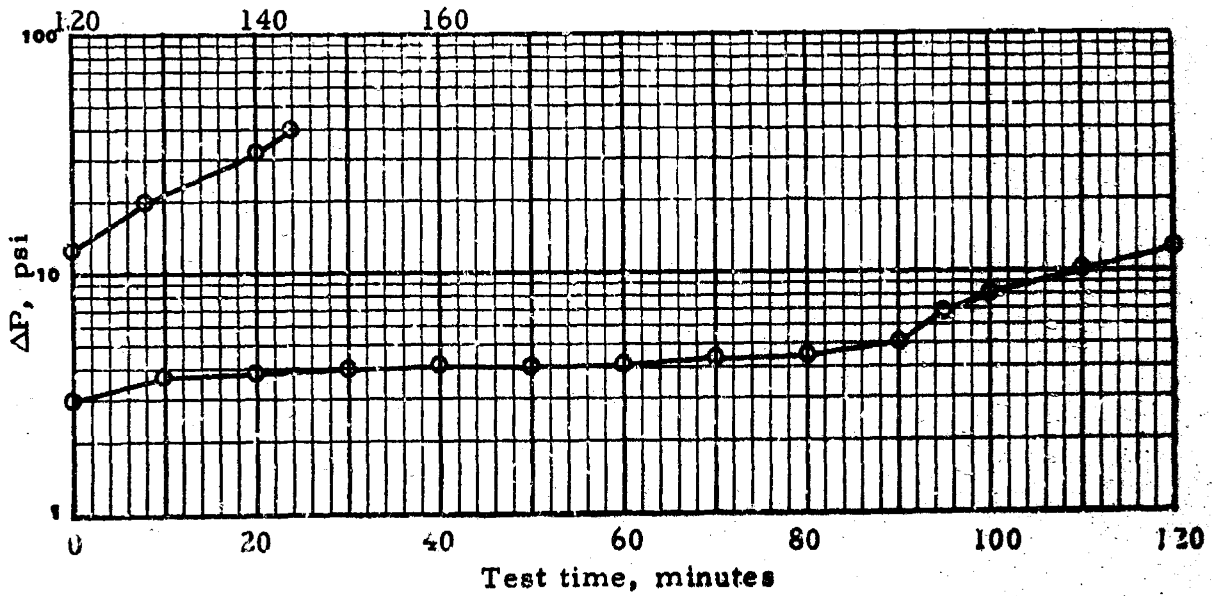


TABLE 12. LOOP TEST NO. 59 Date: 31 March 1967

A1/3S loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.
(x) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119	0.15	vol. %
Corrosion inhibitor, Lubrizol 541, Lot 24794	5	lb/Mbbl

Fuel inlet temperature, °F	75 ± 2	Fuel throughput, gal	3294
Test duration, min	164	Avg. flow rate, gpm	20.1

Actual element weight gain, g	578
Calculated dirt loading, g	589

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.11	0.05	0.09
	WSIM, dist. water	--		--
	WSIM, inj. water	83		88
	IFT, dist. water, dyn/cm	31.4		--
	IFT, inj. water, dyn/cm	25.1		26.8
	FSII content, vol. %	0.14		0.02
Injection water	Solids, mg/liter		0.0	--
	pH		8.0	8.0
	ST, dyn/cm		70.7	71.1
Coalesced water	pH		7.6	7.9
	ST, dyn/cm		55.4	51.5
	FSII content, vol. %		(a)	1.40

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	2	0	0	0	0	0	0
Cleanup ΔP, psi	0	0	0	0	0	0	0
Throughput, gal	324	918	1521	2220	2915	3510	3618

(a) Sample too cloudy to analyze.

TABLE 12. LOOP TEST NO. 59 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids, mg/liter	Free Water, mg/liter	Totamitor Reading
0	3.6			0
10	--			0
20	5.5			0
30	5.5	0.04	3-5	1
40	5.5			0
50	5.8			0
60	5.8			0
70	6.2			0
80	7.0			0
90	7.8			0
95	8.0	0.25	2-4	0
100	8.8			0
110	10.0			0
120	12.5			0
130	15.0	0.06	2-4	0
140	18.6			0
143	20.0	0.18	2-4	0
150	25.6			0
160	35.5			0
163	40.0	0.33	0	0
164	34.5			0

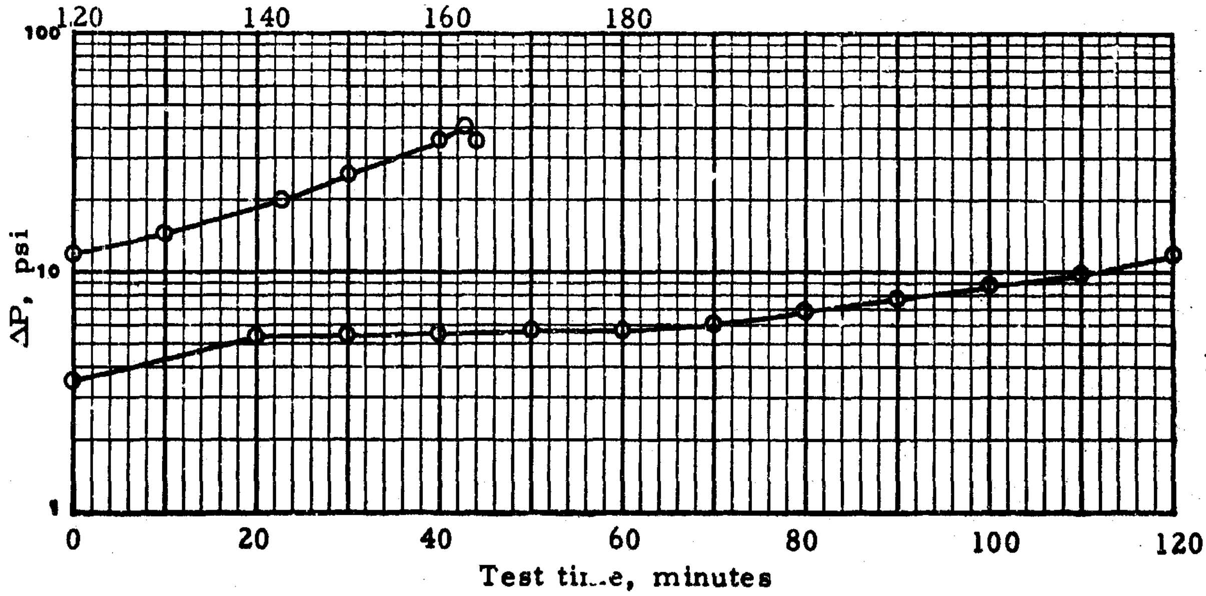


TABLE 13. LOOP TEST NO. 60 Date: 3 April 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.
(x) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119	0.15	vol. %
Corrosion inhibitor	None	lb/Mbbl

Fuel inlet temperature, °F	75 ± 2	Fuel throughput, gal	2772
Test duration, min	138	Avg. flow rate, gpm	20.1

Actual element weight gain, g	414
Calculated dirt loading, g	446

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.12	0.04	0.01
	WSIM, dist. water	83		--
	WSIM, inj. water	90		96
	IFT, dist. water, dyn/cm	42.5		--
	IFT, inj. water, dyn/cm	40.8		42.2
	FSII content, vol. %	0.15		0.01
Injection water	Solids, mg/liter		0.2	--
	pH		7.9	7.9
	ST, dyn/cm		73.2	72.4
Coalesced water	pH		8.0	8.0
	ST, dyn/cm		63.9	69.2
	FSII content, vol. %		4.1	1.2

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	2	2	2	1	0		2
Cleanup ΔP, psi	No readings; gages inoperative.						
Throughput, gal	332	929	1527	2239	2907		3104

TABLE 13. LOOP TEST NO. 60 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids, mg/liter	Free Water, mg/liter	Totamitor Reading
0	4.3			0
10	4.6			0
20	5.0			0
30	5.7	0.03	1-2	0
40	5.3			0
50	5.3			0
60	5.5			0
70	6.0			0
80	6.5			0
90	7.5			0
95	9.0	Neg	0-1	0
100	9.2			0
110	11.5			0
120	15.0			0
127	20.0	0.02	0-1	0
130	23.6			0
138	40.0	Neg	1-2	0
143	39.0			0

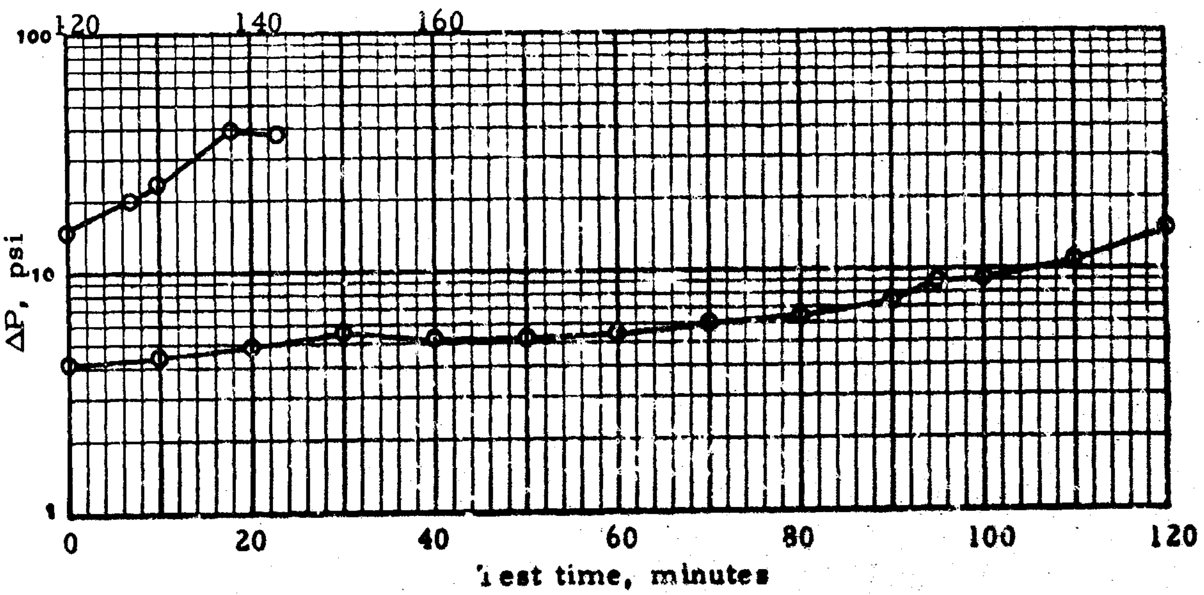


TABLE 14. LOOP TEST NO. 61-A   Date: 5 April 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.
(X) Fresh-fuel blend   OR   ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 08186119   0.15 vol. %
Corrosion inhibitor, None   lb/Mbbl
Other additives: Shell antistatic additive ASA-3, 0.6 mg/liter[a]
Fuel inlet temperature, °F 75 ± 1   Fuel throughput, gal 3229
Test duration, min   162   Avg. flow rate, gpm 19.9

Actual element weight gain, g   568
Calculated dirt loading, g   583

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.00	0.05	0.09
	WSIM, dist. water	90		
	WSIM, inj. water	77		96
	IFT, dist. water, dyn/cm	40.8		
	IFT, inj. water, dyn/cm	35.4		38.5
	FSII content, vol. %	0.13		0.03
Injection water	Solids, mg/liter		0.0	
	pH		8.05	8.20
	ST, dyn/cm		72.6	72.2
Coalesced water	pH		8.30	8.39
	ST, dyn/cm		60.6	66.9
	FSII content, vol. %		6.00	1.90

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	1	1	1	1	1	1	1
Cleanup ΔP, psi	0	0	0	0	0	0	0
Throughput, gal	307	882	1505	2200	2897	3494	3537

a. 0.6 mg/liter of ASA-3 resulted in a conductivity of approximately 210 C.U.

TABLE 14. LOOP TEST NO.61-A(Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading	Conductivity, units[b]
0	3.0			0	
10	3.9			0	
20	3.9			0	
30	4.5	0.13	0-1	0	
40	4.5			0	
50	4.6			0	210
60	4.3			0	210
70	4.3			0	210
80	4.7			0	210
90	5.2			0	210
95	5.6	2.69[a]	0-1	0	210
100	6.0			0	210
110	7.0			0	210
120	8.4			0	210
130	10.0	0.15	5-7	0	210
140	12.1			0	210
150	18.0			0	210
152	20.0	0.21	3-4	0	210
160	34.0			0	205
162	40.6	0.36	4-6	0	205
164	39.5			0	205

a. Filter did not indicate any significant deposit of solids.

b. 1 C.U. = 1 picomho/meter = $10^{-14} ohm^{-1} cm^{-1}$.

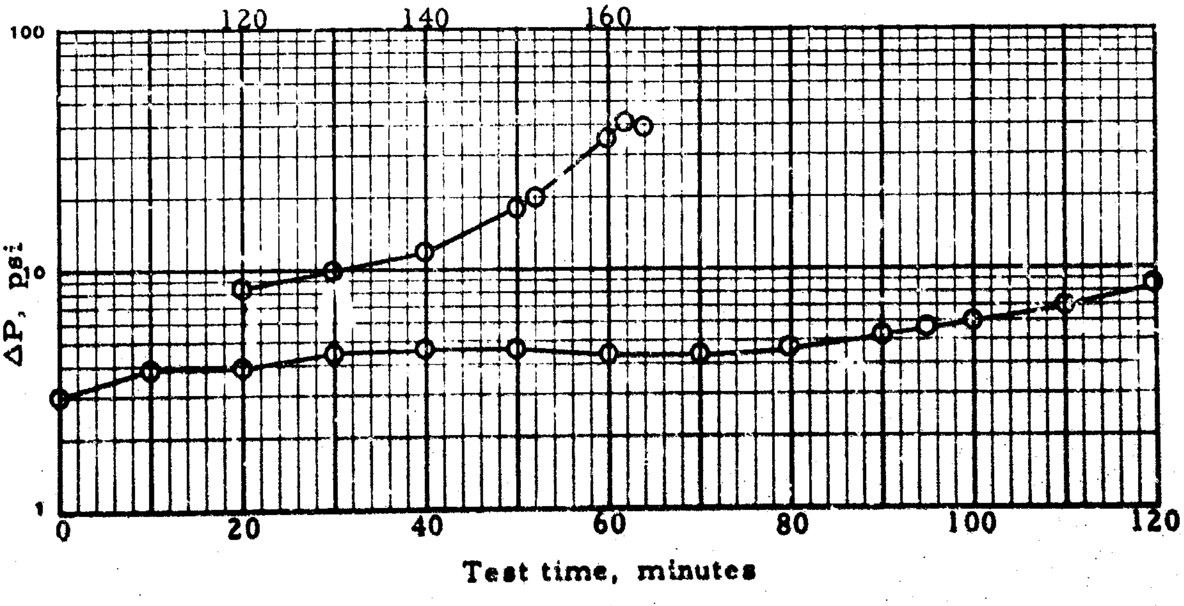


TABLE 15. LOOP TEST NO. 61-B Date: 6 April 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.
( ) Fresh-fuel blend OR (X) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 08186119 0.15 vol. %
Corrosion inhibitor, None lb/Mbbl
Other additives: Shell antistatic additive ASA-3, 0.8 mg/liter[a]
Fuel inlet temperature, °F 75 ± 1 Fuel throughput, gal 3189
Test duration, min 161 Avg. flow rate, gpm 19.9

Actual element weight gain, g 565
Calculated dirt loading, g 575

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	Neg	0.04	0.04
	WSIM, dist. water	b		
	WSIM, inj. water	b		b
	IFT, dist. water, dyn/cm	41.0		
	IFT, inj. water, dyn/cm	39.0		40.8
	FSII content, vol. %	0.12		0.01
Injection water	Solids, mg/liter		0.0	
	pH		8.11	8.10
	ST, dyn/cm		69.4	70.6
Coalesced water	pH		8.20	8.24
	ST, dyn/cm		63.8	68.2
	FSII content, vol. %		3.70	1.00

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	2	2	2	2	2	2	3
Cleanup ΔP, psi	0	0	0	0	0	1	0
Throughput, gal	312	901	1509	2196	2899	3490	3501

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a. 0.8 mg/liter of ASA-3 resulted in a conductivity of approximately 320 C.U.

b. Invalid data; fresh-blend WSIM values were 72 and 74 vs. distilled water and injection water, respectively.

TABLE 15. LOOP TEST NO. 61-B (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading	Conductivity, units[a]
0	3.1			0	310
10	3.8			0	310
20	4.2			0	310
30	4.5	0.07	0-1	0	310
40	4.6			0	320
50	4.5			0	320
60	4.5			0	320
70	4.6			0	320
80	4.8			0	320
90	5.3			0	320
95	5.6	0.02	0-1	0	320
100	6.0			0	320
110	6.2			0	320
120	8.7			0	320
130	10.5	0.03		0	320
140	13.0			0	320
150	18.5			0	320
151	20.0	0.06	0-1	0	320
160	38.0			0	320
161	40.0	0.06	0-1	0	320
163	37.0			0	Post-test 320

a. 1 C.U. = 1 picomho/meter = 10^{-13} ohm^{-1} cm^{-1}

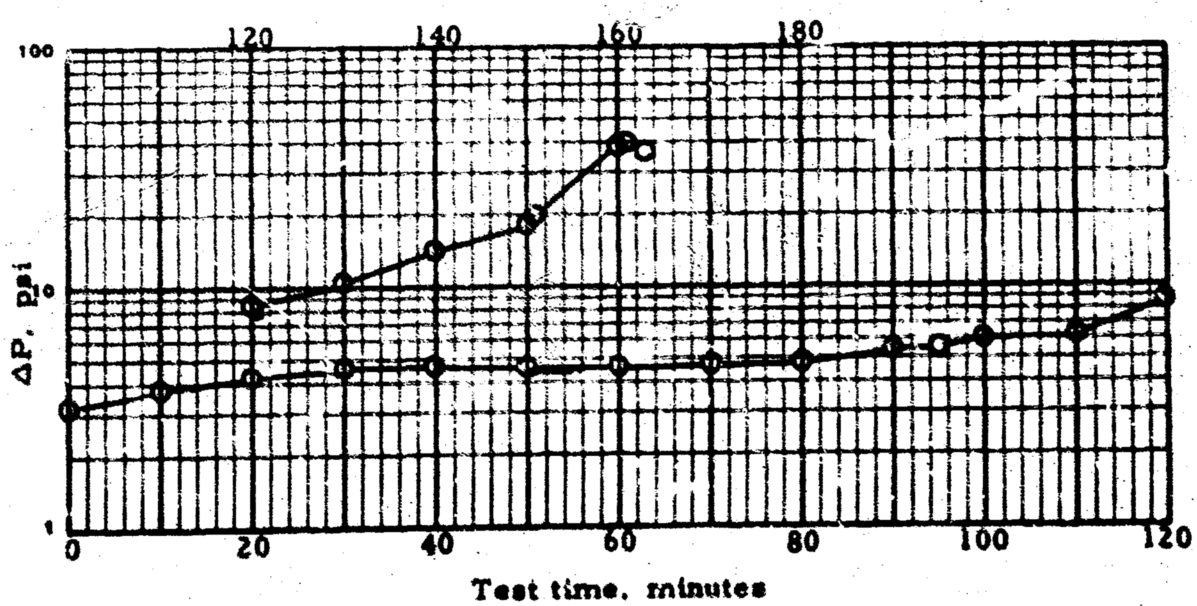


TABLE 16. LOOP TEST NO. 62 Date: 7 April 1967

Al/SS loop with 8" I. D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-4 Batch 14 plus additives as shown.
( ) Fresh-fuel blend OR (X) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119			0.15 vol. %
Corrosion inhibitor, Santolene "C" Lot NH04-006			4 lb/Mbbl
Other additives: Shell antistatic additive ASA-3, 0.8 mg/liter			
Fuel inlet temperature, °F	75 ± 1	Fuel throughput, gal	2741
Test duration, min	137	Avg. flow rate, gpm	20.0

Actual element weight gain, g	433
Calculated dirt loading, g	440

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.06	0.04	0.07
	WSIM, dist. water	a		
	WSIM, inj. water	a		a
	IFT, dist. water, dyn/cm	38.5		
	IFT, inj. water, dyn/cm	23.8		26.7
	FSII content, vol. %	0.16		0.00
Injection water	Solids, mg/liter		0.2	
			8.09	8.18
	ST, dyn/cm		72.6	73.2
Coalesced water	pH		8.12	8.18
	ST, dyn/cm		59.2	67.0
	FSII content, vol. %		6.7	1.8

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	1	2	2	2	2		2
Cleanup ΔP, psi	0	0	0	0	0		0
Throughput, gal	300	900	1505	2197	2903		3041

a. Data invalid because of error in procedure. Fresh-blend WSIM values were 87 and 58 vs. distilled water, 62 vs. injection water.

TABLE 16 . LOOP TEST NO. 62 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Effluent Fuel Quality: Free water, mg/liter	Effluent Fuel Quality: Totamitor Reading		Conductivity, units[a]
0	3.0			0		310
10	4.0			0		300
20	3.9			0		290
30	3.7	0.03	0-1	0		290
40	3.8			0		280
50	4.0			0		275
60	4.0			0		270
70	4.0			0		270
80	4.3			0		270
90	5.1			0		265
95	6.3	Neg.	0-2	0		260
100	7.5			0		260
110	9.8			0		260
120	16.6			0		260
123	20.0	0.05	2	0		260
130	29.5	0.04	[illegible]	0		260
137	40.0	0.06	0-2	0		250
140	31.5			0	Post-test	250

a. 1 C.U. = 1 picomho/meter = 10^{-14} ohm^{-1} cm^{-1}

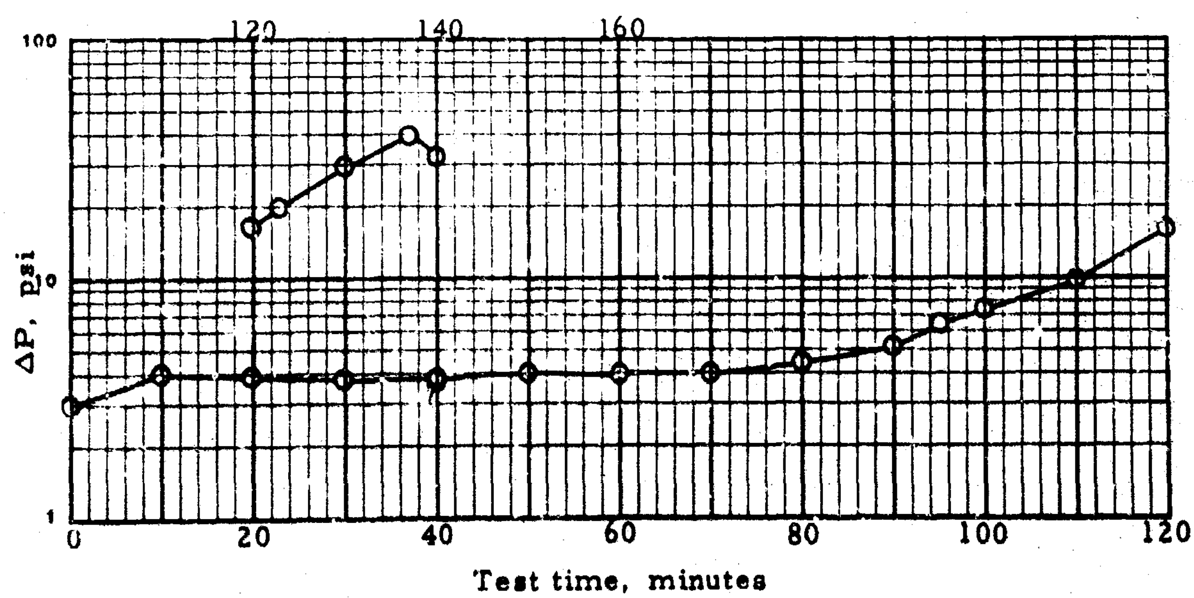


TABLE 17. LOOP TEST NO. 63 Date: 17 April 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 15 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot None vol. %
Corrosion inhibitor None lb/Mbbl

Fuel inlet temperature, °F 80[a]
Test duration, min 133
Fuel throughput, gal 2629
Avg. flow rate, gpm 19.8

Actual element weight gain, g 418
Calculated dirt loading, g 414

		Pre-test	30 min	98 min
Influent fuel	Solids, mg/liter	0.31	0.27	0.08
	WSIM, dist. water	92		
	WSIM, inj. water	78		98
	IFT, dist. water, dyn/cm	39.6		
	IFT, inj. water, dyn/cm	38.0		38.0
	FSII content, vol. %	0.00		0.00
Injection water	Solids, mg/liter		0.8	
	pH		8.15	8.16
	ST, dyn/cm		74.0	74.4
Coalesced water	pH		8.18	8.18
	ST, dyn/cm		72.0	72.5
	FSII content, vol. %		0.00	0.00

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	2	2	0	0	0		0
Cleanup ΔP, psi	0	0	0	0	0		0
Throughput, gal	289	866	1478	2179	2870		2913

a. Fuel temperature could not be brought below 80°F with heat exchanger. Test by ambient temperature (and fuel in tank) were at about 85°F over weekend.

TABLE 17 . LOOP TEST NO. 63 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	3.4			0
10	4.4			0
20	4.8			0
30	4.9	0.17	0-1	0
40	5.0			0
50	5.5			0
60	5.4			0
70	5.6			0
80	6.1			0
90	6.9			0
95	7.3	0.21	0-1	0
100	8.0			0
110	9.5			0
120	12.5			0
125	20.0	0.08	2-4	0
130	29.5	0.00	2-4	0
133	40	0.05	2-4	0
135	41			0

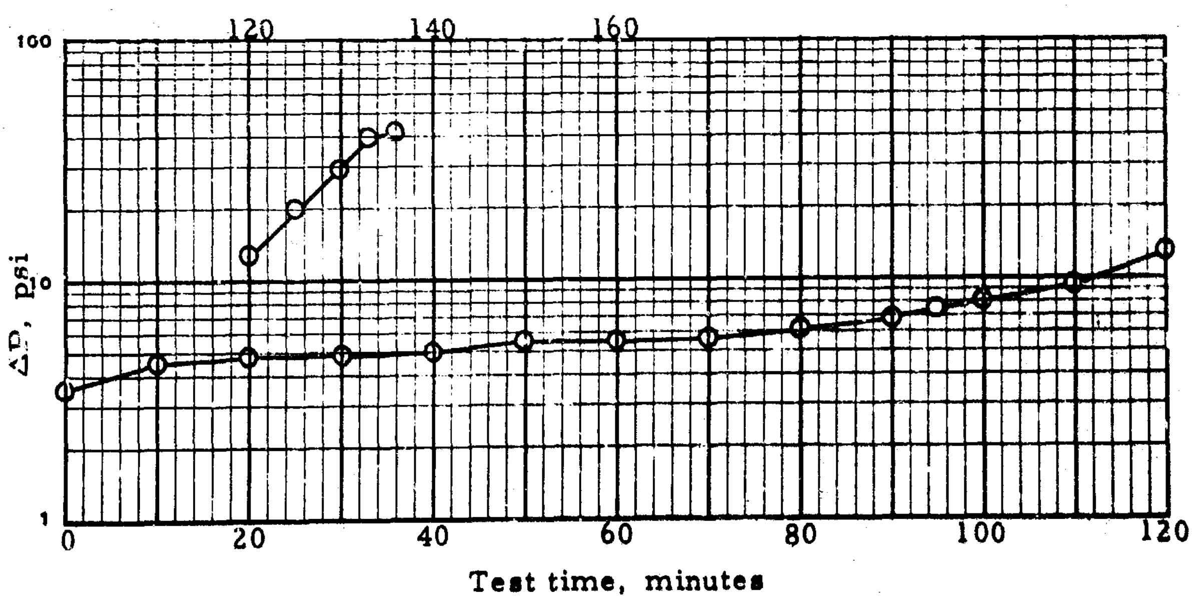


TABLE 18. LOOP TEST NO. 64 Date: 18 April 1967

Al/SS loop with 8" I. D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 15 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 08186119 0.15 vol. %
Corrosion inhibitor, Santolene "C" Lot NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F 75 ± 1 Fuel throughput, gal 1898
Test duration, min 95 Avg. flow rate, gpm 20.0

Actual element weight gain, g 208
Calculated dirt loading, g 200

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.25	0.10	0.05
	WSIM, dist. water	60		
	WSIM, inj. water	46		44
	IFT, dist. water, dyn/cm	28.9		
	IFT, inj. water, dyn/cm	18.3		18.5
	FSII content, vol. %	0.14		0.02
Injection water	Solids, mg/liter		0.1	
	pH		8.25	8.30
	ST, dyn/cm		71.0	72.2
Coalesced water	pH		8.[illegible]8	8.15
	ST, dyn/cm		56.4	62.4
	FSII content, vol. %		4.1	1.4

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	2	2	2	2			2
Cleanup ΔP, psi	0	0	0	1			1
Throughput, gal	318	917	1517	2216			2216

TABLE 18. LOOP TEST NO. 64 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	3.6			0[a]
10	4.9		2-3	2
20	5.2			0
30	5.5	Neg.	0-1	0
40	5.7			0
50	5.8			0
60	5.9			0
70	6.6			0
80	8.1			0
90	18.4			0
91	20.0	0.09	1-2	0
95	45.0	Neg.	0-1	1
97	44.6			0

a. At 2, 4, and 8 min. there were Totamitor peaks of 3, 3, and 2, respectively. It was observed that water droplets were bypassing around bottom of canister screen (because of low water level). At this time, the water level was raised to eliminate this bypassing.

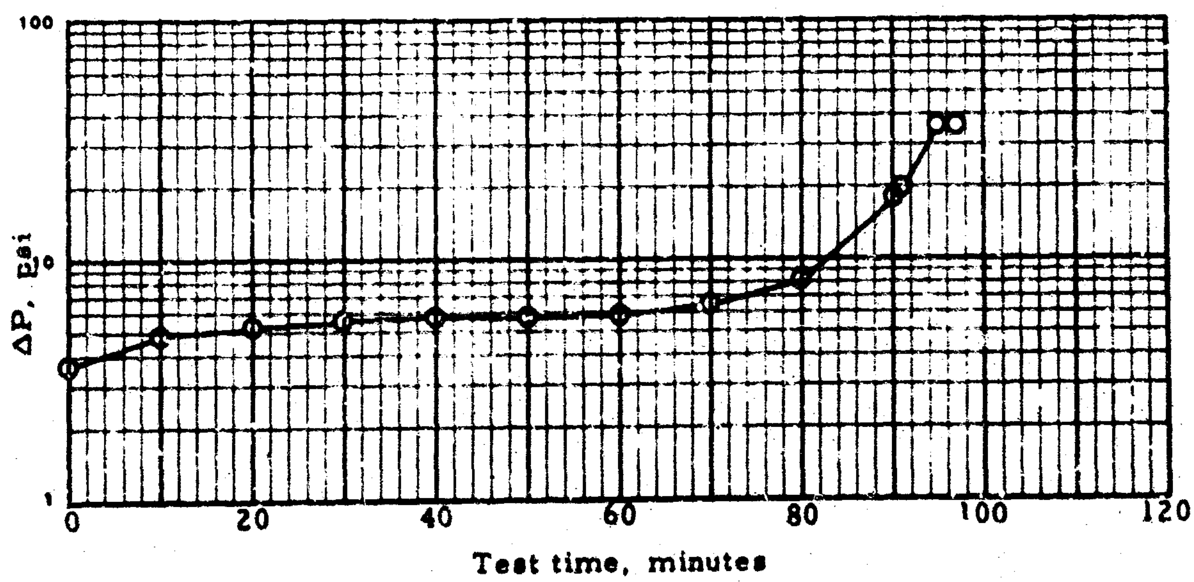


TABLE 19. LOOP TEST NO. 65 Date: 24 April 1967

Al/SS loop with 8" I. D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 15 plus additives as shown.

( ) Fresh-fuel blend OR (X) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 08186119 0.15 vol. %

Corrosion inhibitor, Santolene "C" Lot NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F 75 ± 1 Fuel throughput, gal 1992

Test duration, min 99 Avg. flow rate, gpm 20.1

Actual element weight gain, g [a]

Calculated dirt loading, g 223

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	2.61[b]	0.20	Neg.
	WSIM, dist. water	85		
	WSIM, inj. water	56		76
	IFT, dist. water, dyn/cm	28.6		
	IFT, inj. water, dyn/cm	16.9		19.9
	FSII content, vol. %	0.11		0.01
Injection water	Solids, mg/liter		0.5	
	pH		8.00	8.08
	ST, dyn/cm		72.0	72.4
Coalesced water	pH		8.08	8.07
	ST, dyn/cm		35.4	67.2
	FSII content, vol. %		2.56	0.49

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	1	1			0
Cleanup ΔP, psi	0	0	1	0			0
Throughput, gal	408	1021	1616	2322			2400

a. Element not preweighed: no weight gain data available.

b. Probably in error; filter showed very little deposit.

TABLE 19 . LOOP TEST NO. 65 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.0			0
10	4.8			0
20	5.0			0
30	5.3	0.47	0-1	0
40	5.5			0
50	5.5			0
60	5.6			0
70	6.0			0
80	7.0			0
90	11.0			0
95	29.5	Neg.	1-2	0
99	40.0	Neg.	0-1	0
101	43.0			0

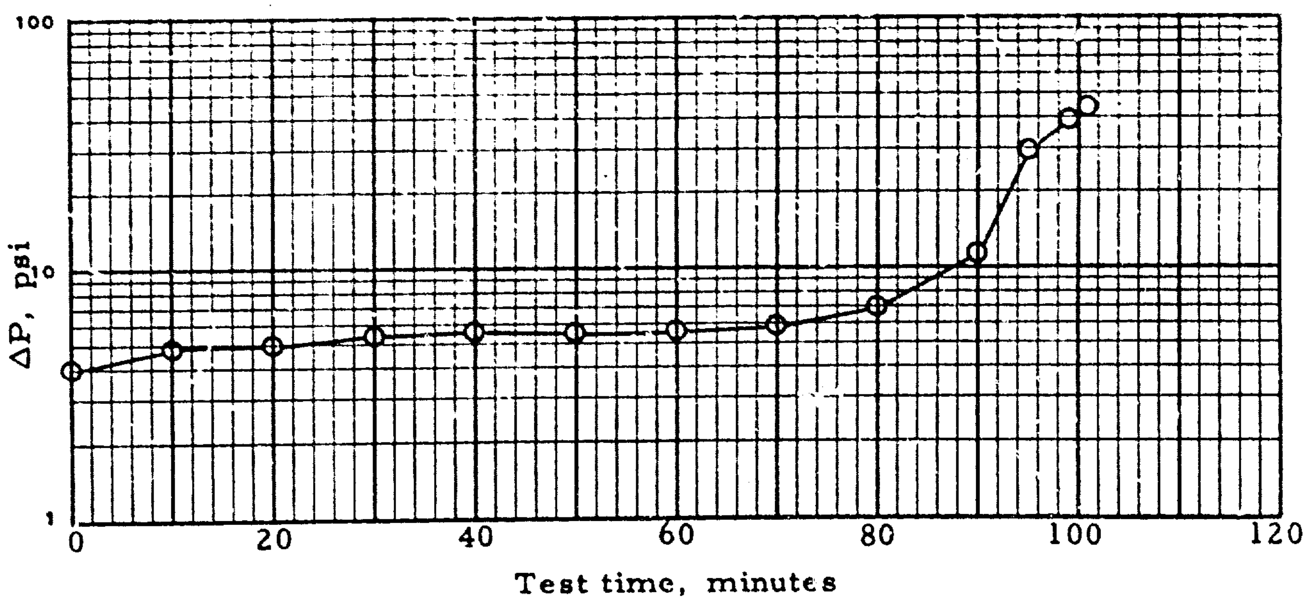


TABLE 20. LOOP TEST NO. 66 Date: 25 April 1967

Al/SS loop with 8" I.D. aluminum housing with 6.5" I.D. insert, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).
Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 15 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 08186119 0.15 vol. %
Corrosion inhibitor Santolene "C" Lot NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F 75
Test duration, min 85
Fuel throughput, gal 1689
Avg. flow rate, gpm 19.9

Actual element weight gain, g 163
Calculated dirt loading, g 143

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.29	0.14	
	WSIM, dist. water	77		
	WSIM, inj. water	32		
	IFT, dist. water, dyn/cm	33.1		
	IFT, inj. water, dyn/cm	18.9		
	FSII content, vol. %	0.16		
Injection water	Solids, mg/liter		0.1	
	pH		8.05	
	ST, dyn/cm		72.4	
Coalesced water	pH		8.08	
	ST, dyn/cm		54.8	
	FSII content, vol. %		3.95	

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	1	1	0				0
Cleanup ΔP, psi	0	0	0				2
Throughput, gal	308	891	1494				1997

TABLE 20. LOOP TEST NO. 66 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Effluent Fuel Quality: Free water, mg/liter	Effluent Fuel Quality: Totamitor Reading
0	4.0			0
10	5.0			0
20	5.5			0
30	5.6	0.03	0	0
40	6.2			0
50	6.4			0
60	6.5			0
70	7.5			0
80	16.0			0
82	20.0	Neg.	1-3	0
85	40.0	Neg.	2-3	0
87	48.0			0

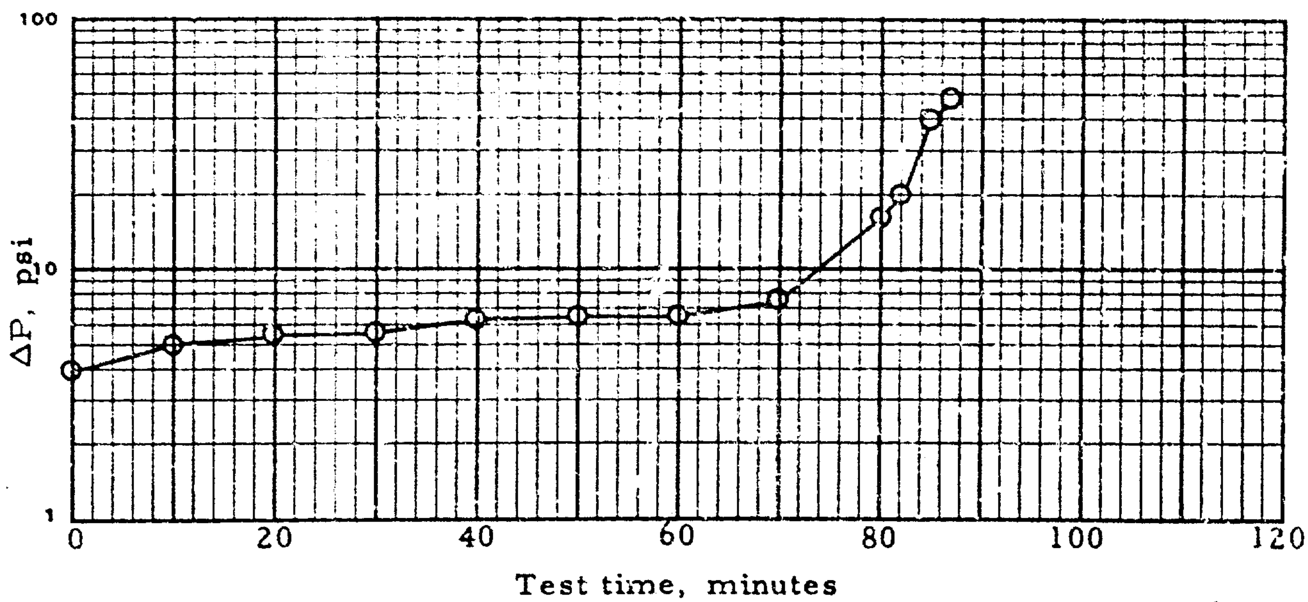


TABLE 21. LOOP TEST NO. 67 Date: 26 April 1967

Al/SS loop with 3" I.D. aluminum housing with 6.5" I.D. insert, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch plus additives as shown.
( ) Fresh-fuel blend OR (X) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 08186119 0.15 vol. %
Corrosion inhibitor Santolene "C" Lot NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F 75 ± 1 Fuel throughput, gal 1946
Test duration, min 98 Avg. flow rate, gpm 19.9

Actual element weight gain, g 205
Calculated dirt loading, g 217

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.00	0.04	Neg.
	WSIM, dist. water	81		
	WSIM, inj. water	58		77
	IFT, dist. water, dyn/cm	32.4		
	IFT, inj. water, dyn/cm	18.9		20.6
	FSII content, vol. %	0.18		0.02
Injection water	Solids, mg/liter		0.0	
	pH		8.15	8.20
	ST, dyn/cm		72.3	71.6
Coalesced water	pH		8.20	8.12
	ST, dyn/cm		54.0	54.5
	FSII content, vol. %		4.46	1.52

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	280	870	1478	2138			2226

TABLE 21. LOOP TEST NO. 67 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	3.5			0
10	4.5			0
20	4.8			0
30	5.0	Neg.	0-1	0
40	5.1			0
50	5.1			0
60	5.2			0
70	5.5			0
80	6.4			0
90	14.5			0
93	20.0	Neg.	0-1	0
96	40.0	0.10	a	2
100	28.0			0

a. Sample volume too large (over 1000 ml); pad rated 12-14

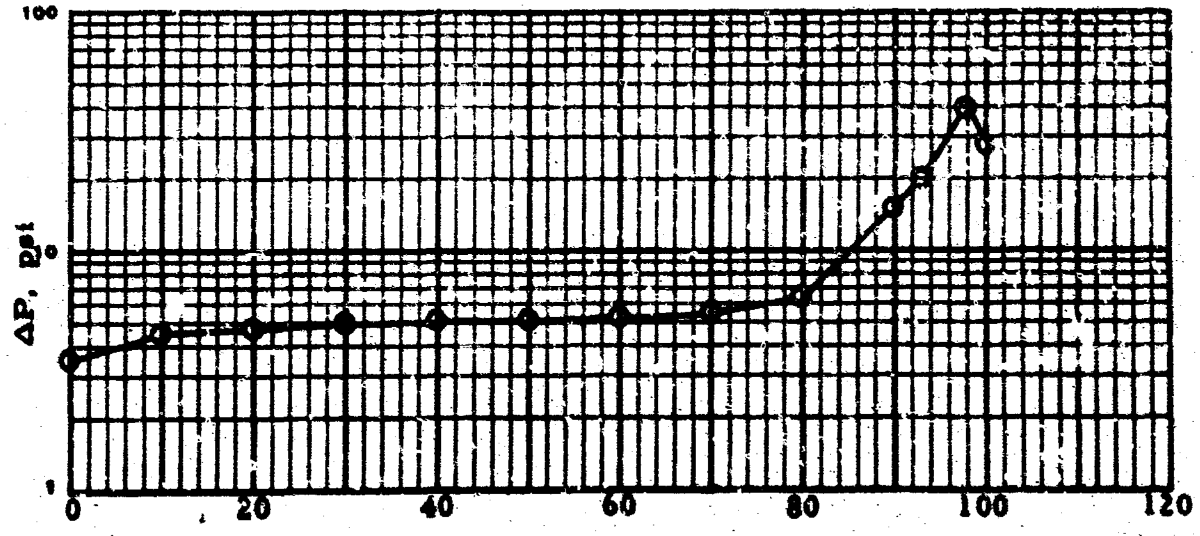


TABLE 22. LOOP TEST NO. 68 Date: 27 April 1967

Al/SS loop with 8" I.D. aluminum housing with 6.5" I.D. insert, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 15 plus additives as shown.
( ) Fresh-fuel blend OR (X) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 08186119 0.15 vol. %
Corrosion inhibitor, Santolene "C" Lot NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F 75 ± 1
Test duration, min 107
Fuel throughput, gal 2132
Avg. flow rate, gpm 19.9

Actual element weight gain, g 267
Calculated dirt loading, g 269

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	Neg.	0.05	Neg.
	WSIM, dist. water	73		
	WSIM, inj. water	58		60
	IFT, dist. water, dyn/cm	39.5		
	IFT, inj. water, dyn/cm	21.8		21.6[a]
	FSII content, vol. %	0.15		0.03
Injection water	Solids, mg/liter		0.2	
	pH		8.10	8.20[a]
	ST, dyn/cm		72.4	70.7[a]
Coalesced water	pH		8.05	8.10
	ST, dyn/cm		36.1	66.1
	FSII content, vol. %		3.64	0.98

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	1	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	296	900	1506	2189			2428

a. Final injection water sample taken post-test rather than at 95 min.

TABLE 22. LOOP TEST NO. 68 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading[a]
0	3.2			0/0[b]
10	4.2			0/0
20	4.3			0/0
30	4.4	Neg.	0-1	1/0
40	4.5			1/0
50	4.5			1/0
60	4.4			1/0
70	4.4			1/0
80	5.0			1/0
90	6.4			1/0
95	8.6	Neg.		2/1
100	18.0			1/1
102	20.0	0.33	0-1	1/1
107	40.0	0.03	3-4	1/1
110	31.0			0/0

a. Influent and effluent Totamitor readings.
b. Totamitor peak of 8 after one minute's flow; presumed to be caused by insufficient water-seal layer in test housing.

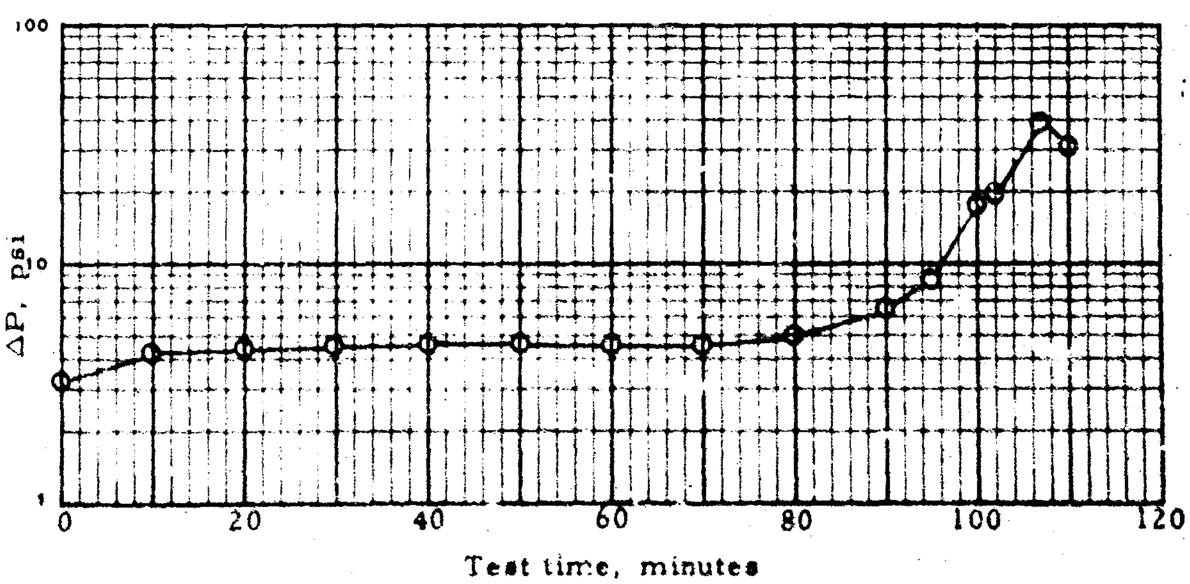


TABLE 23. LOOP TEST NO. 69 Date: 28 April 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 15 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 08186119 0.15 vol. %
Corrosion inhibitor, Santolene "C" Lot NH04-006 4 lb/Mbbl

Fuel inlet temperature, °F 75 ± 1
Test duration, min 97
Fuel throughput, gal 1953
Avg. flow rate, gpm 20.8

Actual element weight gain, g 203
Calculated dirt loading, g 212

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	Neg.	Neg.	0.05
	WSIM, dist. water	82		
	WSIM, inj. water	85		92
	IFT, dist. water, dyn/cm	41.3		
	IFT, inj. water, dyn/cm	35.2		33.6
	FSII content, vol. %	0.15		0.02
Injection water	Solids, mg/liter		0.2	
	pH		8.05	8.10
	ST, dyn/cm		73.5	74.4
Coalesced water	pH		8.15	8.10
	ST, dyn/cm		57.1	66.5
	FSII content, vol. %		4.18	---

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	3	6	4	5			5
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	304	890	1507	2173			2296

TABLE 23. LOOP TEST NO. 69 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality Solids mg/liter	Free water, mg/liter	Totamitor Readings[a]
0	4.0			0/0
10	5.0			0/0
20	5.2			0/0
30	5.5	0.10	0-1	0/0
40	5.6			0/0
50	5.9			0/0
60	6.0			0/0
70	6.3			0/0
80	7.5			0/0
90	13.9			0/0
93	20.0	0.04	0-1	0/0
97	40.0	2.13[b]	0-1	0/0

a. Influent and effluent Totamitor readings.

b. Probable error; no significant amount of solids visible on test filter.

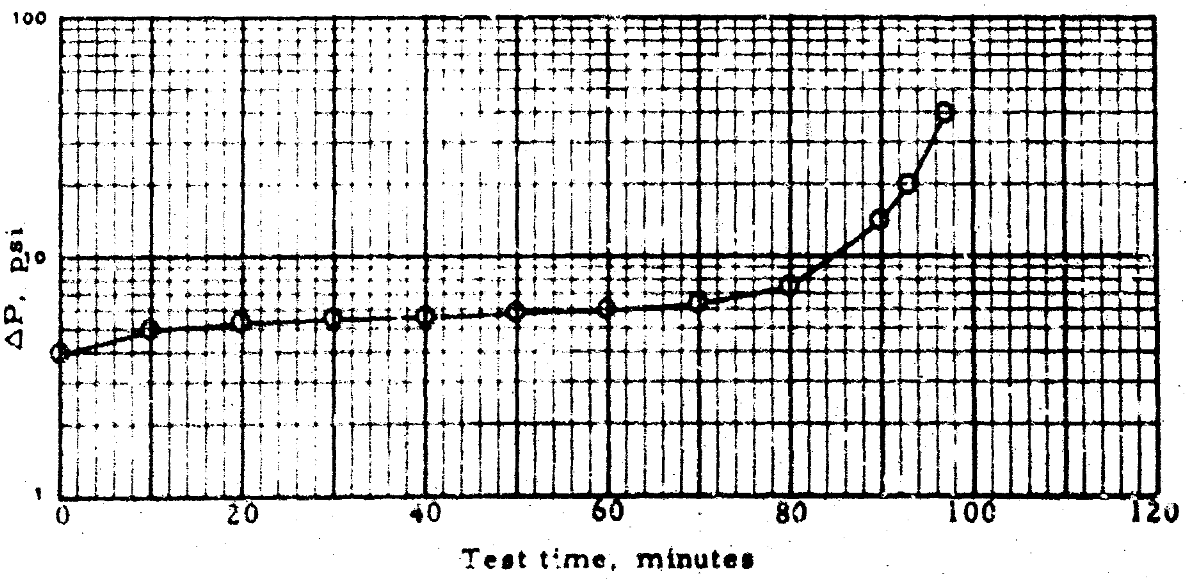


TABLE 24. LOOP TEST NO. 70 Date: 1 May 1967

Al/SS loop with 8" I. D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 15 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 08186119 0.15 vol. %
Corrosion inhibitor, Santolene "C" Lot NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F 75 ± 2
Test duration, min 92
Fuel throughput, gal 1837
Avg. flow rate, gpm 20.0

Actual element weight gain, g 183
Calculated dirt loading, g 183

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.56	0.26	Neg.
	WSIM, dist. water	66		
	WSIM, inj. water	75		80
	IFT, dist. water, dyn/cm	39.0		
	IFT, inj. water, dyn/cm	21.2		21.0
	FSII content, vol. %	0.16		0.03
Injection water	Solids, mg/liter		0.3	
	pH		8.05	8.20
	ST, dyn/cm		72.4	72.4
Coalesced water	pH		8.1	8.1
	ST, dyn/cm		54.4	57.9
	FSII content, vol. %		3.11	1.29

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	1	1	1	1			1
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	300	897	1519	2137			2137

TABLE 24. LOOP TEST NO. 70 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading[a]
0	4.5			0/0
10	5.5			0/0
20	6.0			0/0
30	7.5	0.12	0-1	0/0
40	6.2			0/0
50	6.4			0/0
60	6.5			0/0
70	7.0			0/0
80	9.4			0/0
88	20.0	0.09	0-2	0/0
90	32.5			0/0
92	40.0	0.03	0-1	0/0
95				0/0
97				0/0

a. Influent and effluent Totamitor readings.

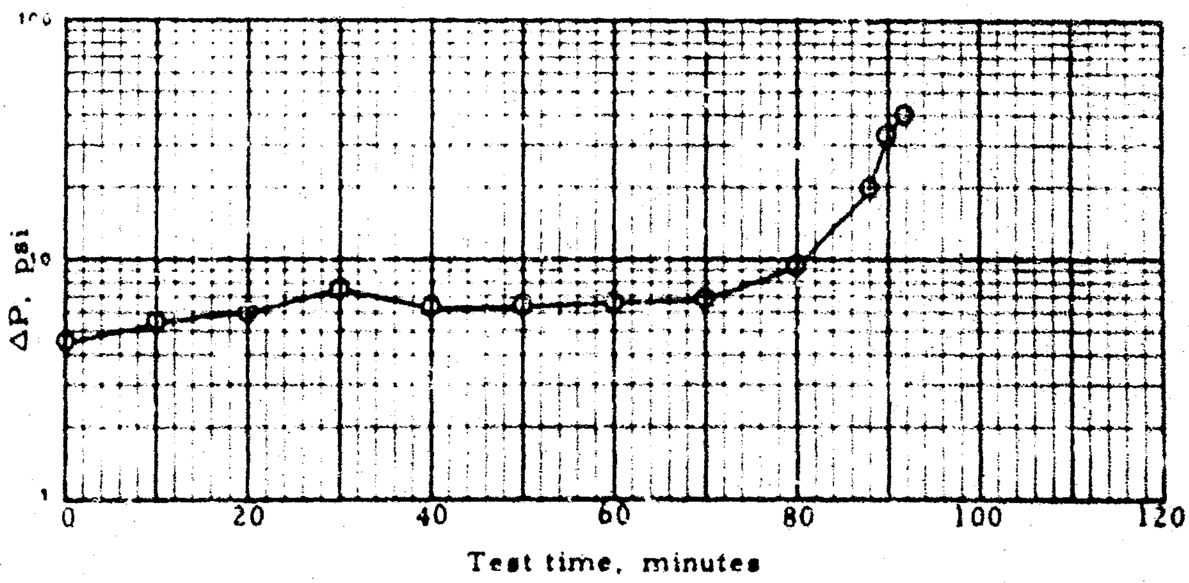


TABLE 25. LOOP TEST NO. 71 Date: 2 May 1967

Al/SS loop with 8" I.D. aluminum housing with 6.5" I.D. insert, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 15 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 08186119 0.15 vol. %
Corrosion inhibitor, Santolene "C" Lot NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F 75 ± 1 Fuel throughput, gal 1985.8
Test duration, min 97 Avg. flow rate, gpm 20.5

Actual element weight gain, g 209
Calculated dirt loading, g 212

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.05	0.03	Neg.
	WSIM, dist. water	77		
	WSIM, inj. water	78		71
	IFT, dist. water, dyn/cm	35.2		
	IFT, inj. water, dyn/cm	23.4		20.4
	FSII content, vol. %	0.14		0.02
Injection water	Solids, mg/liter		0.0	
	pH		8.09	8.10
	ST, dyn/cm		72.6	71.5
Coalesced water	pH		8.02	8.08
	ST, dyn/cm		37.2	63.7
	FSII content, vol. %		2.90	1.21

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	1	1	1	1			1
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	281	906	1508	2212			2267

TABLE 25. LOOP TEST NO. 71 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	3.5			0[a]
10	4.5			0
20	4.6			0
30	4.6	0.10	0-1	0
40	5.0			0
50	5.0			0
60	5.0			0
70	5.5			0
80	6.3			0
90	15.2			2[b]
95	31.2	Neg.	8-10	3
97	48.0	0.02	12-14	3
99				0

a. Effluent Totamitor showed maximum reading of 6 shortly after start of water injection, continuing for 3 to 4 minutes; attributed to passage of water prior to buildup of water layer barrier.

b. Effluent Totamitor readings of 2-5 were recorded following 89 minutes of test time; were apparently due to water.

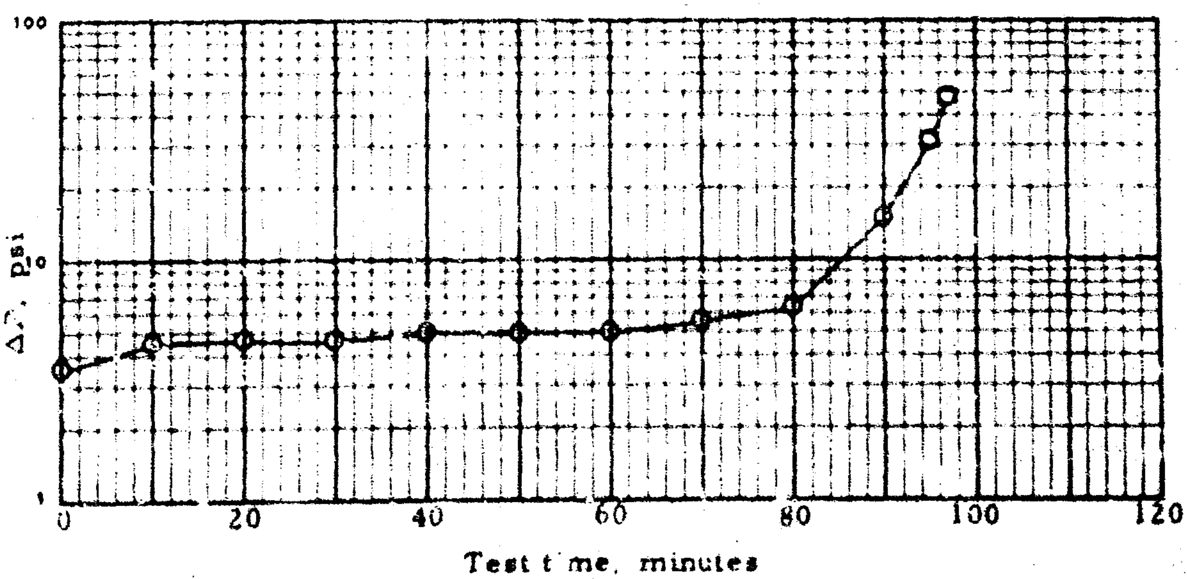


TABLE 26. LOOP TEST NO. 72 Date: 4 May 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 15 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 08186119 0.15 vol. %
Corrosion inhibitor, Santolene "C" Lot NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F	75 ± 2	Fuel throughput, gal	1725
Test duration, min	87	Avg. flow rate, gpm	19.8

Actual element weight gain, g 147
Calculated dirt loading, g 154

		Pre-test	30 min	87 min
Influent fuel	Solids, mg/liter	0.26	0.18	0.09
	WSIM, dist. water	80		
	WSIM, inj. water	78		50
	IFT, dist. water, dyn/cm	35.9		
	IFT, inj. water, dyn/cm	21.5		20.6
	FSII content, vol. %	0.16		0.03
Injection water	Solids, mg/liter		Neg.	
	pH		8.10	8.10
	ST, dyn/cm		72.0	72.8
Coalesced water	pH		8.05	8.05
	ST, dyn/cm		54.9	57.0
	FSII content, vol. %		3.77	1.65

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	1	1				1
Cleanup ΔP, psi	1	0	0				1
Throughput, gal	311	904	1502				[illegible]

TABLE 26. LOOP TEST NO. 72 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.9			0[a]
10	5.5			0
20	5.6			0
30	6.3	0.03	0-1	0
40	6.4			0
50	6.5			0
60	6.9			0
70	8.1			0
80	18.5			0
81	20.0	0.08	0-1	0
87	40.0	0.00	1-2	0
90	36.4			0

a. Effluent Totamitor showed maximum reading of 2 shortly after start of water injection, continuing for 3 to 4 minutes; attributed to passage of water prior to buildup of water layer barrier.

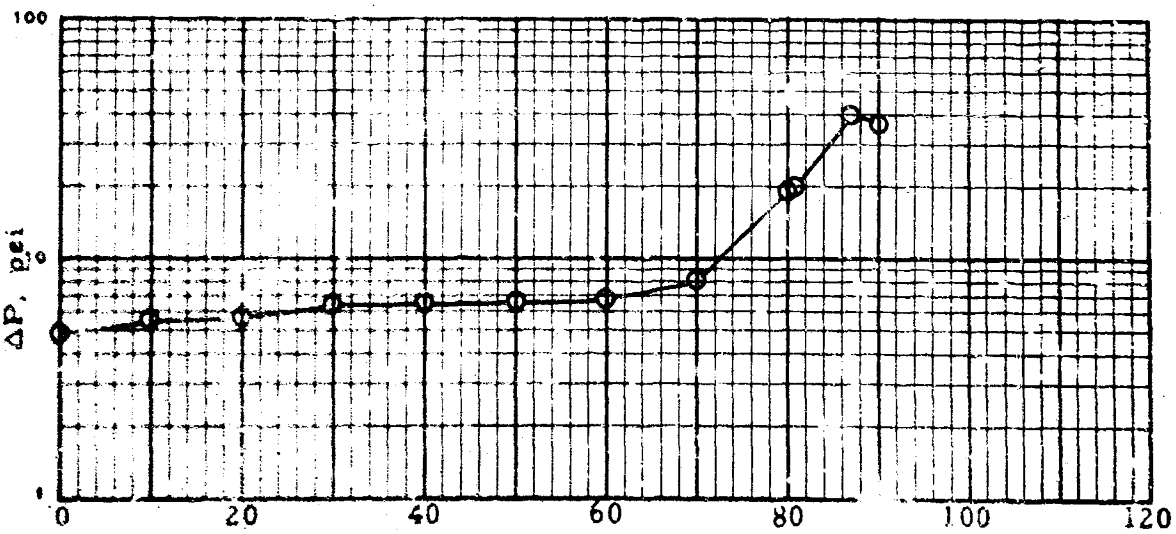


TABLE 27. LOOP TEST NO. 73 Date: 5 May 1967

Al-SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4206, Lot 286).

Procedure 16: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 15 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot None vol. %
Corrosion inhibitor, Santolene "C" Lot NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F	75 ± 1	Fuel throughput, gal	1790
Test duration, min	90	Avg. flow rate, gpm	19.9

Actual element weight gain, g 165
Calculated dirt loading, g 172

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.11	Neg.	0.02
	WSIM, dist. water	60[a]		
	WSIM, inj. water	71		77
	IFT, dist. water, dyn/cm	35.1		
	IFT, inj. water, dyn/cm	19.1		19.7
	FSII content, vol. %	0.0		b
Injection water	Solids, mg/liter		0.2	
	pH		7.98	8.06
	ST, dyn/cm		72.4	72.4
Coalesced water	pH		7.95	8.04
	ST, dyn/cm		58.6	64.4
	FSII content, vol. %		b	b

Time, min	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	12	0	1				0
Cleanup ΔP, psi	0	0	0				0
Throughput, gal	296	883	1459				2086

a. Error in test technique; test result questionable.
b. Analyses not required.

TABLE 27. LOOP TEST NO. 73 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	3.5			0
10	5.3			0
15	5.6			0[a]
20	5.3			0
30	5.1	0.09	0-1	0
40	5.5			0
50	5.5			0
60	5.5			0
70	6.3			0
80	10.1			0
86	20.0	0.12	0-1	0
90	40.0	0.08	0	0
97	38.0			0

a. Flow interrupted 15 min to clean emulsification screen.

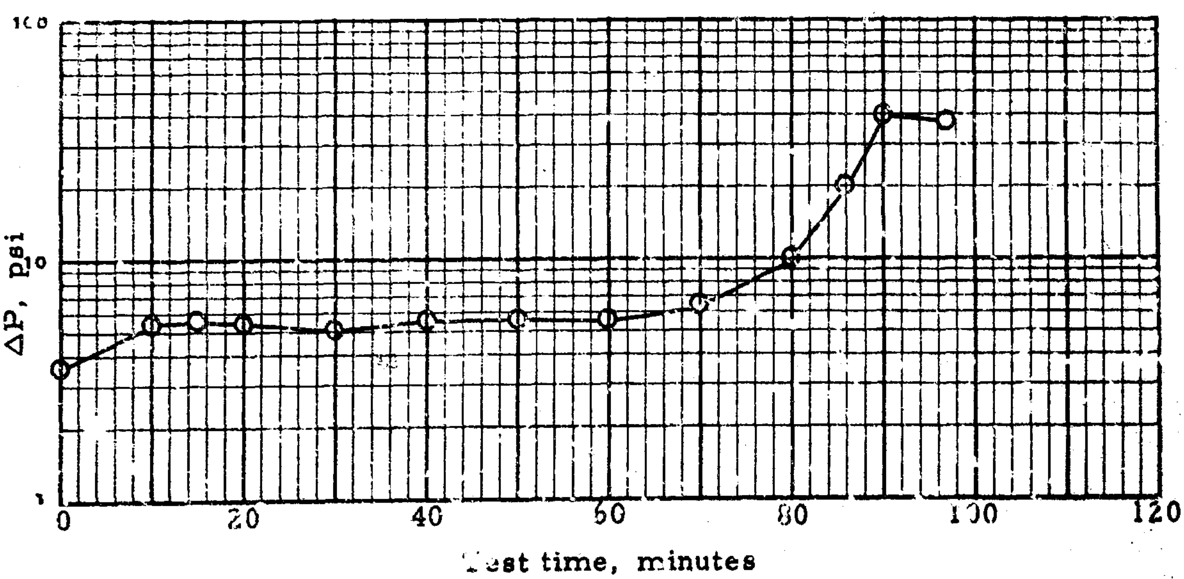


TABLE 28. LOOP TEST NO. 74 Date: 10 May 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Special water (distilled water + 115 mg/liter Na Cl + 0.1 N HCl to 5 pH)[a] injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.
Test fuel uninhibited JP-5 Batch 15 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 08186119 0.15 vol. %
Corrosion inhibitor, Santolene "C" Lot NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F	75 ± 1	Fuel throughput, gal	1980
Test duration, min	99	Avg. flow rate, gpm	20.0

Actual element weight gain, g 203
Calculated dirt loading, g 223

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.15	0.08	0.02
	WSIM, dist. water	70		
	WSIM, inj. water	72		70
	IFT, dist. water, dyn/cm	29.5		
	IFT, inj. water, dyn/cm	30.6		30.1
	FSII content, vol. %	0.14		0.02
Injection water	Solids, mg/liter		---	
	pH		5.15	5.09
	ST, dyn/cm		72.5	72.4
Coalesced water	pH		---	---[b]
	ST, dyn/cm		57.6	57.2[b]
	FSII content, vol. %		3.34	1.29

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	300	900	1499	2191			2280

a. Additional Cl^- 1.5 mg/liter.

b.

Minutes	5	30	60	95	99
Coalesced water pH	5.92	---	5.40	---	---
Coalesced water ST	54.5	57.6	58.4	57.2	57.0

TABLE 28. LOOP TEST NO. 74 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.1			0[a]
5	5.1			0
10	5.5			0
20	5.5			0
30	5.6	0.18	0-1	0
40	5.6			0
50	5.6			0
60	5.7			0
70	6.0			0
80	7.5			0
90	13.0			0
95	20.0	0.07	0-1	0
99	40.0	0.07	0-2	0

a. Effluent Totamitor showed maximum reading of 1 shortly after start of water injection, continuing for 3 to 4 minutes; attributed to passage of water prior to buildup of water layer barrier.

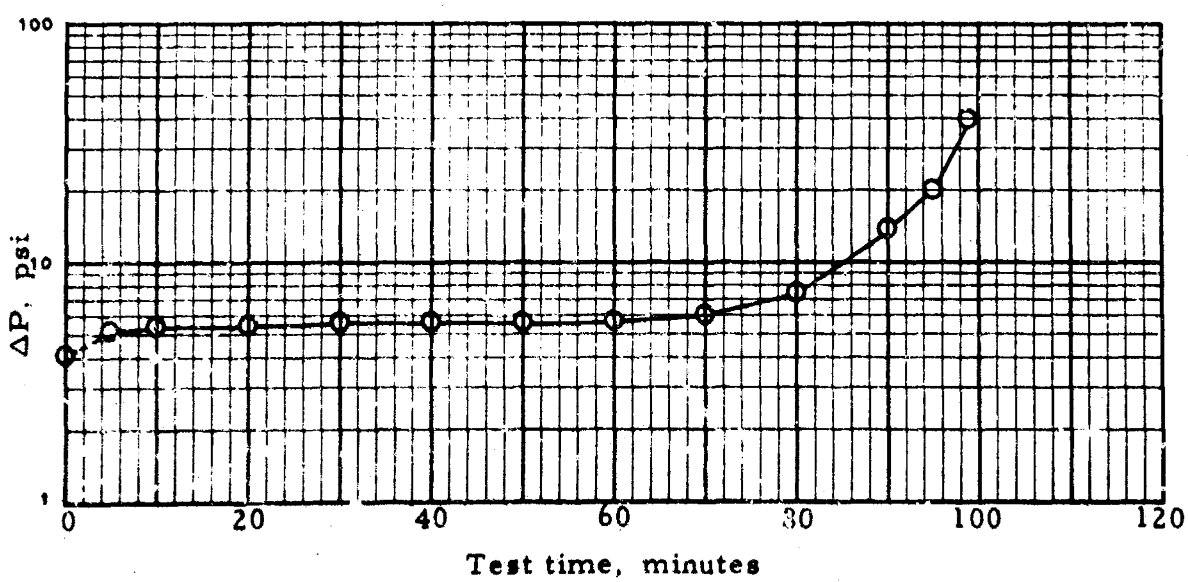


TABLE 29. LOOP TEST NO. 75 Date: 11 May 1967

Al/SS loop with 8" I. D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4203, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Special water (distilled water + 115 mg/liter Na Cl + 0.1 N NaOH to 7 pH)[a] injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.
Test fuel uninhibited JP-5 Batch 15 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 08186119 0.15 vol. %
Corrosion inhibitor, Santolene "C" Lot NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F	75 ± 1	Fuel throughput, gal	1938
Test duration, min	97	Avg. flow rate, gpm	20.0

Actual element weight gain, g 212
Calculated dirt loading, g 198

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.26	0.06	Neg.
	WSIM, dist. water	76		
	WSIM, inj. water	84		75
	IFT, dist. water, dyn/cm	35.1		
	IFT, inj. water, dyn/cm	35.1		35.7
	FSII content, vol. %	0.16		0.03
Injection water	Solids, mg/liter		0.0	
	pH		7.10	7.25
	ST, dyn/cm		71.0	72.5
Coalesced water	pH		6.30	7.15[b]
	ST, dyn/cm		60.0	57.2 [b]
	FSII content, vol. %		3.81	1.48

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	298	899	1497	2196			2236

---

a. Additional Na^+ 0.7 mg/liter

b.

Minutes	5	30	60	95	97	Post-test
Coalesced water pH	6.20	6.30	6.50	7.15	7.15	7.20
Coalesced water ST	60.7	60.0	63.0	57.2	54.5	---

TABLE 29. LOOP TEST NO. 75 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.1			0[a]
5	5.2			0
10	5.5			0
20	5.8			0
30	6.0	Neg.	0-1	0
40	5.9			0
50	6.0			0
60	6.1			0
70	6.6			0
80	8.4			0
90	16.6			0
92	20.0			0
95	29.5	0.02	0-1	0
97	40.0	Neg.	0-1	0

a. Effluent Totamitor showed maximum reading of 1 shortly after start of water injection, continuing for 3 to 4 minutes; attributed to passage of water prior to buildup of water layer barrier.

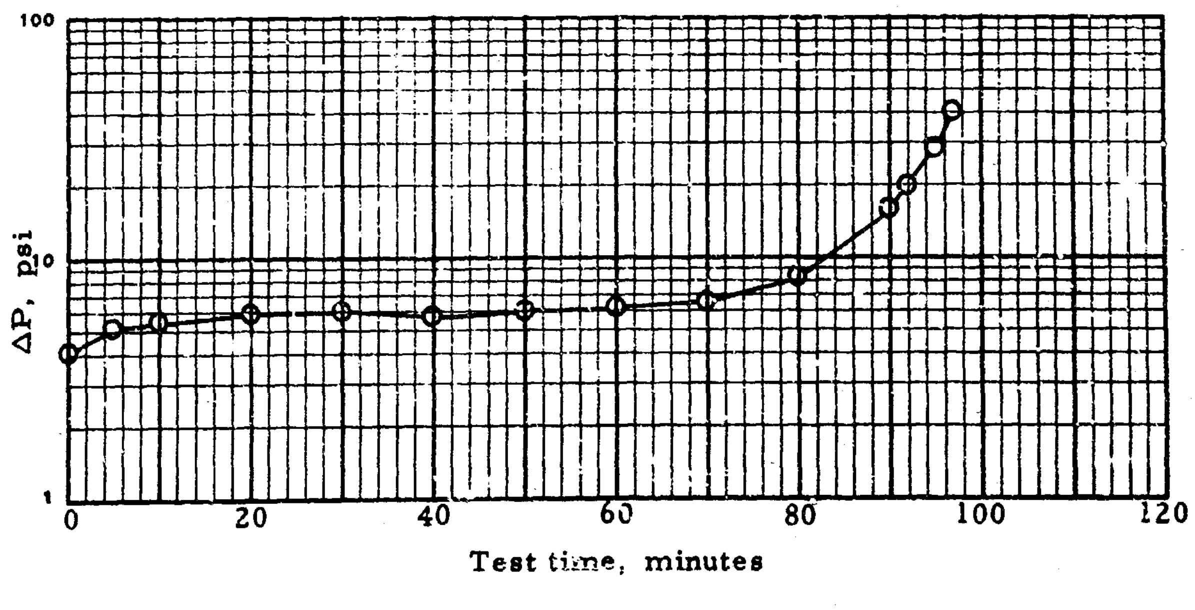


TABLE 30. LOOP TEST NO. 76 Date: 12 May 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Special water (distilled water + 115 mg/liter NaCl + 0.1 N NaOH to 10 pH)[a] injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.
Test fuel uninhibited JP-5 Batch 15 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow,	Lot 08186119	0.15 vol. %
Corrosion inhibitor, Santolene "C"	Lot NH04-006	16 lb/Mbbl

Fuel inlet temperature, °F	75 ± 1	Fuel throughput, gal	1888
Test duration, min	95	Avg. flow rate, gpm	19.9

Actual element weight gain, g	201
Calculated dirt loading, g	200

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.39	0.02	0.07
	WSIM, dist. water	70		
	WSIM, inj. water	63		80
	IFT, dist. water, dyn/cm	36.6		
	IFT, inj. water, dyn/cm	20.8		20.8
	FSII content, vol. %	0.15		0.05
Injection water	Solids, mg/liter		0.0	
	pH		9.94	9.96[b]
	ST, dyn/cm		70.3	71.3
Coalesced water	pH		7.51	7.80[b]
	ST, dyn/cm		56.9	60.0[b]
	FSII content, vol. %		3.99	0.58

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	296	896	1497	2184			2184

---

a. Additional Na^+ 4.6 mg/liter.

b.

Minutes	0	5	15	30	45	60	75	90	95
Inj. water pH	9.94	---	9.99	9.94	9.94	9.97	9.94	9.98	9.96
Coal. water pH	---	7.40	---	7.51	---	7.79	---	---	7.80
Coal. water ST	---	54.4	---	56.9	---	56.8	---	---	60.0

TABLE 30. LOOP TEST NO. 76 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	3.9			0[a]
5	5.0			0
10	5.2			0
15	5.3			0
20	5.5			0
30	5.7	0.02	0-1	0
40	5.9			0
45	6.0			0
50	6.0			0
60	6.2			1
70	6.9			0
75	8.0			0
80	9.9			0
90	20.0	Neg.	0-1	0
95	40.0	0.06	0-1	0

a. Effluent Totamitor showed maximum reading of 2 shortly after start of water injection, continuing for 3 to 4 minutes; attributed to passage of water prior to buildup of water layer barrier.

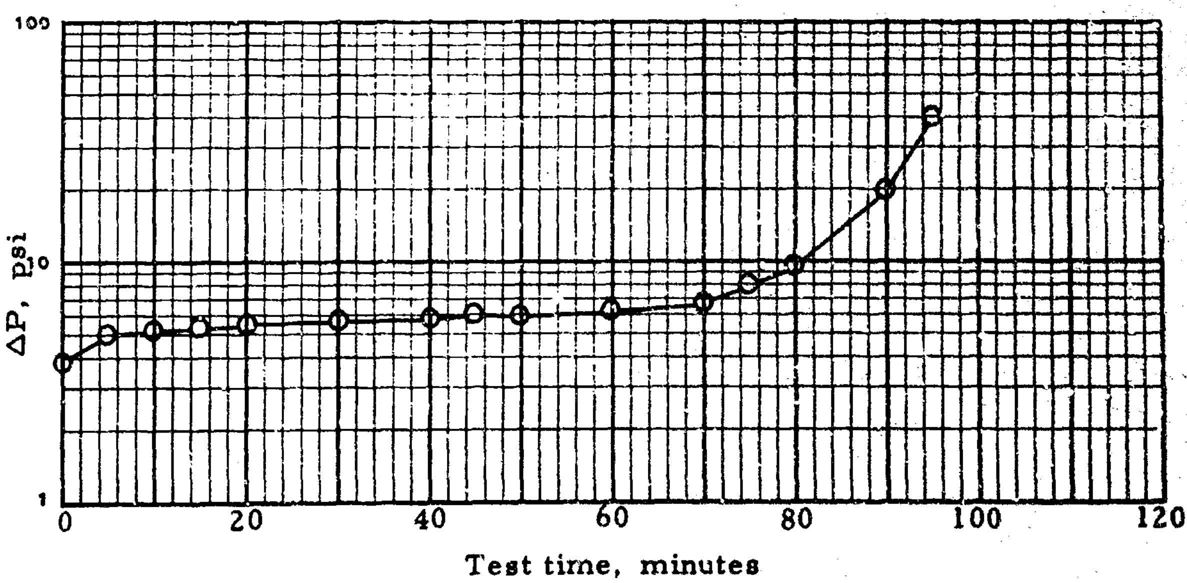


TABLE 31. LOOP TEST NO. 77 Date: 27 May 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 16 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 08186119 0.15 vol. %
Corrosion inhibitor, Santolene "C" Lot NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F	75 ± 1	Fuel throughput, gal	1715
Test duration, min	87	Avg. flow rate, gpm	19.7

Actual element weight gain, g 158
Calculated dirt loading, g 154

		Pre-test	30 min	87 min
Influent fuel	Solids, mg/liter	0.02	0.06	0.04
	WSIM, dist. water	87		
	WSIM, inj. water	79		71
	IFT, dist. water, dyn/cm	36.8		
	IFT, inj. water, dyn/cm	21.2		22.1
	FSII content, vol. %	0.13		0.03
Injection water	Solids, mg/liter		0.0	
	pH		8.20	8.22
	ST, dyn/cm		70.8	72.6
Coalesced water	pH		8.10	8.08[a]
	ST, dyn/cm		58.2	59.6
	FSII content, vol. %		4.60	1.40

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0				0
Cleanup ΔP, psi	0	0	0				0
Throughput, gal	329	925	1529				2044

---

a.

Minutes		5	30	60	87
Coalesc...	pH	8.05	8.10	8.08	8.08
Coalesce...	ST	55.3	58.2	57.5	59.6

TABLE 31. LOOP TEST NO. 77 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.5			0[a]
10	5.5			0
20	5.9			0
30	6.1	0.22	0	0
40	6.5			0
50	6.5			0
60	6.3			0
70	6.9			0
80	14.9			0
83	20.0	Neg.	3-4	0
87	40.0	Neg.	3-4	0

a. Effluent Totamitor showed maximum reading of 2 shortly after start of water injection, continuing for 3 to 4 minutes; attributed to passage of water prior to buildup of water layer barrier.

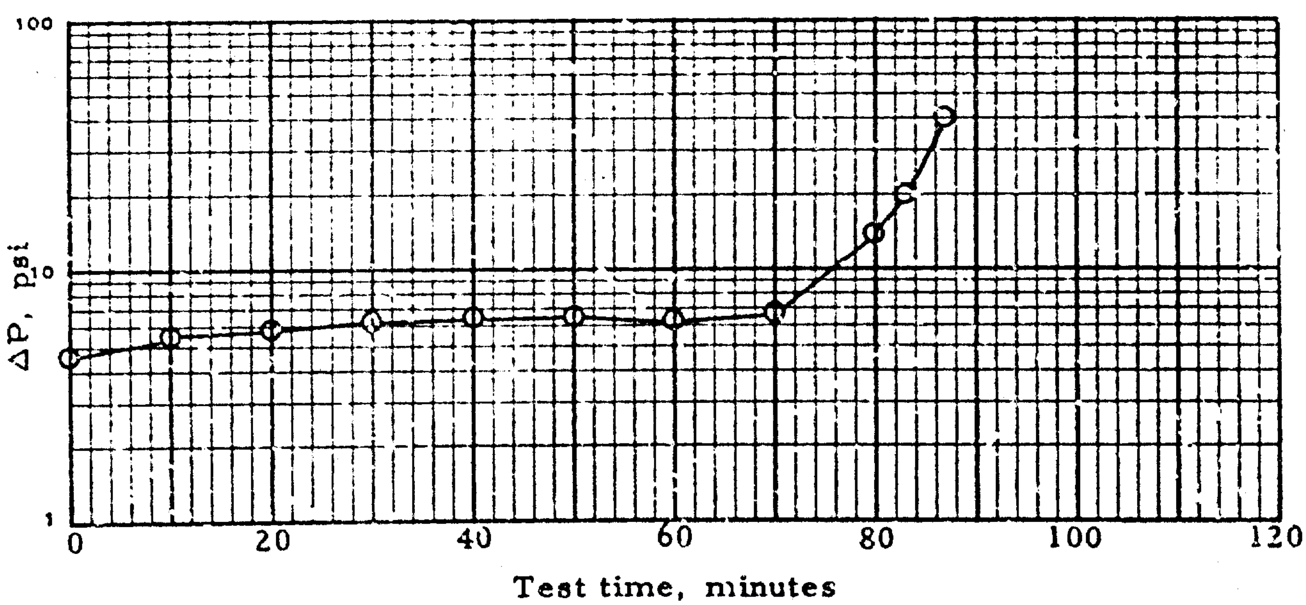


TABLE 32. LOOP TEST NO. 78 Date: 18 May 1967

A1/S6 loop with 8" I. D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Special water (65% type B synthetic water, 35% FSII by volume) injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 16 plus additives as shown.

(X) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 0306720		0.15 vol. %
Corrosion inhibitor, Santolene "C" Lot NH04-006		16 lb/Mbbl

Fuel inlet temperature, °F	75 ± 2	Fuel throughput, gal	1919
Test duration, min	97[b]	Avg. flow rate, gpm	19.8

Actual element weight gain, g	179
Calculated dirt loading, g	183

		Pre-test	30 min	93 min
Influent fuel	Solids, mg/liter	0.32	0.15	0.04
	WSIM, dist. water	77		
	WSIM, inj. water	74		56
	IFT, dist. water, dyn/cm	35.7		
	IFT, inj. water, dyn/cm	18.3		18.1
	FSII content, vol. %	0.14		0.15
Injection water	Solids, mg/liter		2.0	
	pH		7.61	7.67
	ST, dyn/cm		46.6	47.1
Coalesced water	pH		7.93	7.97[a]
	ST, dyn/cm		45.4	40.0[a]
	FSII content, vol. %		33.0	35.0

Time, min:	Pre-test	30	60	93	130	160	End
Screen ΔP, psi	0	0	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	307	902	1504	2137			2226

a. Minutes	5	30	65	93	97
Coalesced water pH	7.87	7.93	7.93	7.97	7.99
Coalesced water ST	47.4	45.4	25.2	40.0	42.2

b. Total test time of 97 minutes included only 32 minutes of solids injection, since start of solids injection was delayed 5 minutes.

TABLE 32. LOOP TEST NO. 78 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.3			0[a]
10	5.5			0
20	6.4			0
30	6.6	0.08	3-4	0
40	7.0			0
50	7.8			0
60	7.8			0
65	7.5			0[b]
70	8.2			0
80	8.8			0
90	14.0			0
93	20.0	0.26	2-4	0
95	---	0.13	2-4	0
97	40.0	0.05	2-4	0

a. Effluent Totamitor showed maximum reading of 2 shortly after start of water injection, continuing for 3 to 4 minutes; attributed to passage of water prior to buildup of water layer barrier.

b. Delay of 5 minutes due to mechanical repairs of injection system. Solids injection started at 65 min.

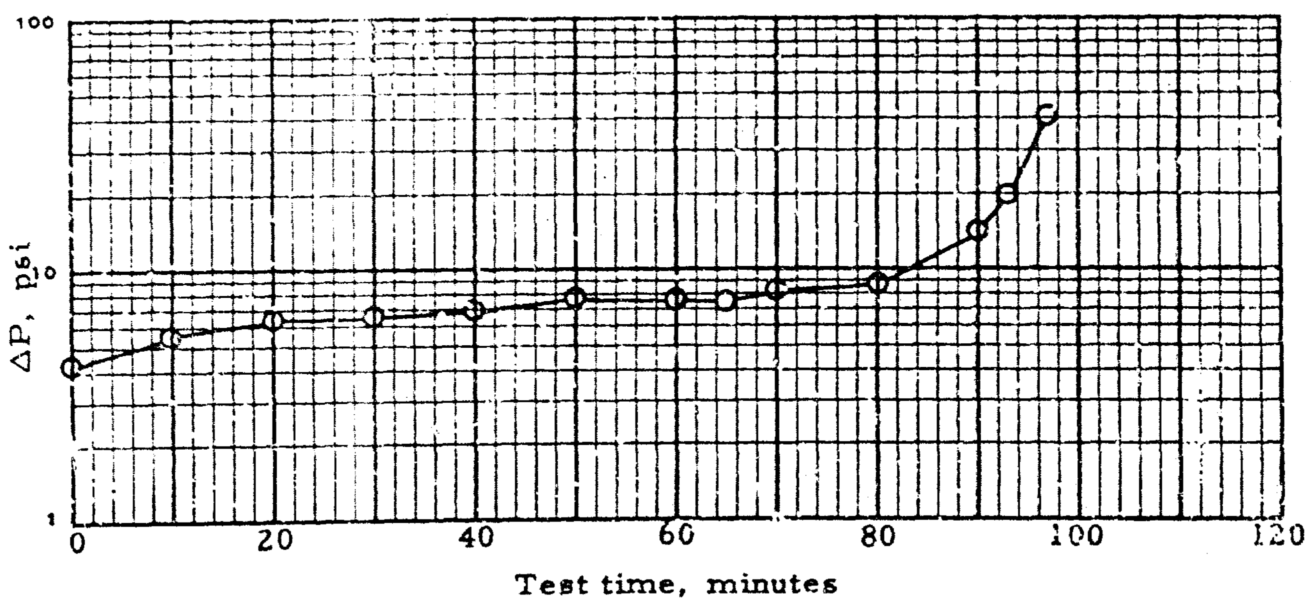


TABLE [illegible]. LOOP TEST NO. 7[illegible]   Date: 22 May 1967

[illegible] loop with [illegible] I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Wilbers No. I-4228, Lot [illegible]).

Procedure [illegible]: Modified MIL-F-[illegible]A inhibited-fuel test with fuel flow [illegible] gpm and inlet pressure [illegible] psig. Special water ([illegible]% type II synthetic water, [illegible] by volume) injected at [illegible] gpm throughout test; coarse AC dust at [illegible] g/min after [illegible] min
Test fuel uninhibited JP-4 Batch [illegible] plus additives as shown.
(XX) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, [illegible], Lot [illegible]   [illegible] vol %
Corrosion inhibitor, Santolene "C" Lot [illegible]   [illegible] lb/MBbl

Test fuel temperature, °F [illegible] ± [illegible]   Fuel throughput, gal [illegible]
Test duration, min [illegible]   Avg. flow rate, gpm [illegible]

Actual element weight gain, g [illegible]
Calculated dirt loading, g [illegible]

		Pre-test	[illegible] min	[illegible] min
Effluent fuel	Solids, mg/liter	[illegible]	[illegible]	[illegible]
	WSIM, dist. water	[illegible]		
	WSIM, inj. water	[illegible]		[illegible]
	IFT, dist. water, dyn/cm	[illegible]		
	IFT, inj. water, dyn/cm	[illegible]		[illegible]
	FSII content, vol %	[illegible]		[illegible]
Injected water	Solids, mg/liter		[illegible]	
	pH		[illegible]	[illegible]
	[illegible]		[illegible]	[illegible]
Coalesced water	pH		[illegible]	[illegible][a]
	[illegible]		[illegible]	[illegible][a]
	FSII content, vol %		[illegible]	[illegible][a]

Test, min	Pre-test	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	End
[illegible] ΔP, psi	-	-	-	-			-
[illegible] ΔP, psi	1	[illegible]	-	1			1
Throughput, gal	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]

a. Minutes	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Coalesced water pH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Coalesced water [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Coalesced water % FSII	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 33. LOOP TEST NO. 79 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.5			0[a]
5	5.0			0
10	5.1			0
20	5.1			0
30	5.1	Neg.	1-2	0
40	5.5			0
50	5.5			0
60	5.6			0
70	6.0			0
80	7.5			0
90	11.5			0
95	17.0	Neg.	2-3	0
98	20.0			0
100	28.5			0
102	40.0	Neg.	2-3	0
105	35.0			0

a. Totamitor reading of 1 at 1 minute due to passage of water which may occur prior to build-up of a water layer barrier at the bottom of test housing.

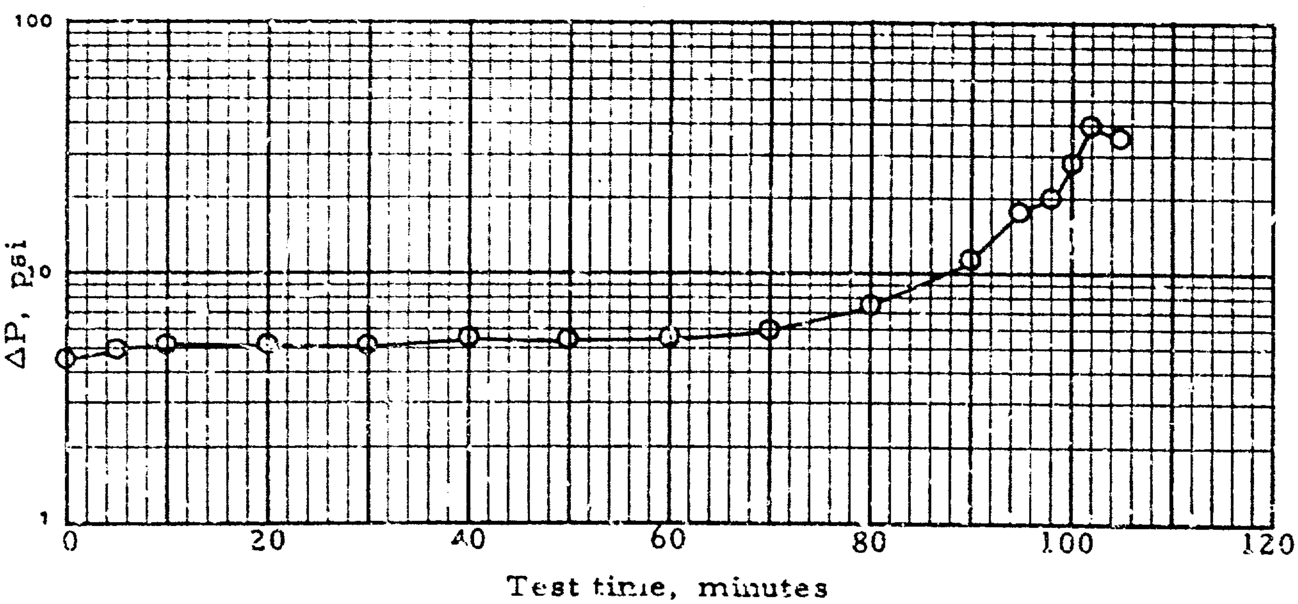


TABLE 34. LOOP TEST NO. 80 Date: 23 May 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 16 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 0306720 0.15 vol. %
Corrosion inhibitor, None lb/Mbbl

Fuel inlet temperature, °F 75 ± 2 Fuel throughput, gal 2382
Test duration, min 119 Avg. flow rate, gpm 20.0

Actual element weight gain, g 320
Calculated dirt loading, g 338

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.27	0.11	0.08
	WSIM, dist. water	91		
	WSIM, inj. water	79		88
	IFT, dist. water, dyn/cm	43.4		
	IFT, inj. water, dyn/cm	36.8		38.9
	FSII content, vol. %	0.14		0.10
Injection water	Solids, mg/liter		0.3	
	pH		8.29	8.30
	ST, dyn/cm		72.3	70.7
	$NaHCO_3$, mg/liter		164.7	164.7
Coalesced water	pH		8.22	8.38[a]
	ST, dyn/cm		61.2	62.6 [a]
	FSII content, vol. %		3.20	1.40[a]

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	1	4	1	1			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	301	907	1517	2215			2682

a.

Minutes	5	30	60	95	119
Coalesced water pH	8.21	8.22	8.28	8.38	---
Coalesced water ST	55.0	61.2	61.6	62.6	---
Coalesced water % FSII	4.00	3.20	2.00	1.40	1.40

TABLE 34. LOOP TEST NO. 80 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.5			0
5	5.2			0
10	5.4			0
20	5.6			0[a]
30	6.5	0.09	0-1	0
40	5.9			0
50	5.9			0
60	6.0			0
70	6.5			0
80	7.3			0
90	9.0			0
95	10.7	0.14	0-1	0
100	11.8			0
110	17.0			0
112	20.0	0.00	0-1	0[b]
119	40.0	0.03	0-1	0

a. Effluent Totamitor reading 1 at 25 min.

b. Effluent Totamitor reading 2 at 116 min.

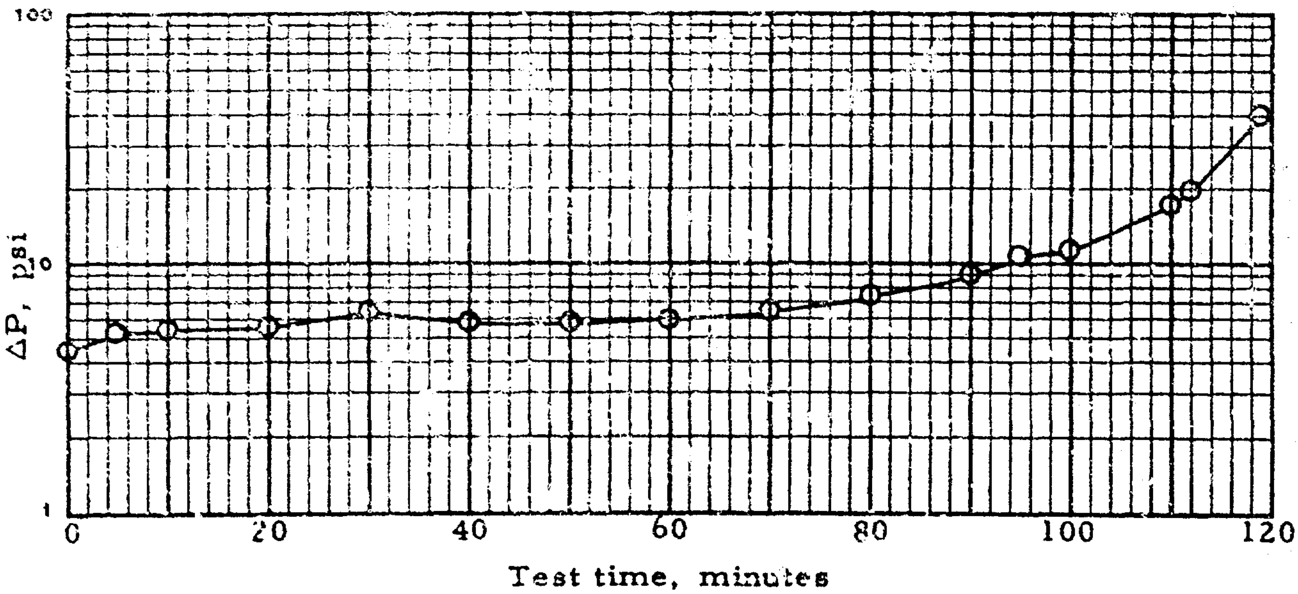


TABLE 35. LOOP TEST NO. 81 Date: 26 May 1967

Al/SS loop with 8" I. D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Special water (65% type B synthetic water, 35% FSII by volume) injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.
Test fuel uninhibited JP-5 Batch 16 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 0306720 0.15 vol. %
Corrosion inhibitor None lb/Mbbl

Fuel inlet temperature, °F	75 ± 5	Fuel throughput, gal	2111
Test duration, min	107	Avg. flow rate, gpm	19.7

Actual element weight gain, g 263
Calculated dirt loading, g 269

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.10	0.12	0.08
	WSIM, dist. water	95		
	WSIM, inj. water	95		95
	IFT, dist. water, dyn/cm	46.2		
	IFT, inj. water, dyn/cm	21.8		21.6
	FSII content, vol. %	0.13		0.16
Injection water	Solids, mg/liter		1.3	
	pH		7.72	7.74
	ST, dyn/cm		46.8	45.8
Coalesced water	pH		8.11	8.20[a]
	ST, dyn/cm		45.2	46.2 [a]
	FSII content, vol. %		34.0	34.0 [a]

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	1	0	1	0			1
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	300	876	1479	2174			2411

---

a.					
Minutes	5	30	60	95	107
Coalesced water pH	8.10	8.11	8.16	8.20	8.22
Coalesced water ST	43.2	45.2	45.3	46.2	44.6
Coalesced water % FSII	30.0	34.0	36.0	34.0	34.0

TABLE 35. LOOP TEST NO. 81 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.9			0
10	5.0			0
20	5.6			0
30	6.0	Neg.	0-1	0
40	6.3			0
50	6.5			0
60	6.5	0.02	0	0
70	7.2			0
80	8.0			0
90	10.6			0
95	15.7	Neg.	0-1	0[a]
100	19.0			0
101	20.0	Neg.	0-1	0
107	40.0	Neg.	0-1	0[b]

a. Effluent Totamitor reading 2 at 93 min.

b. Effluent Totamitor reading 6 at 104 min.

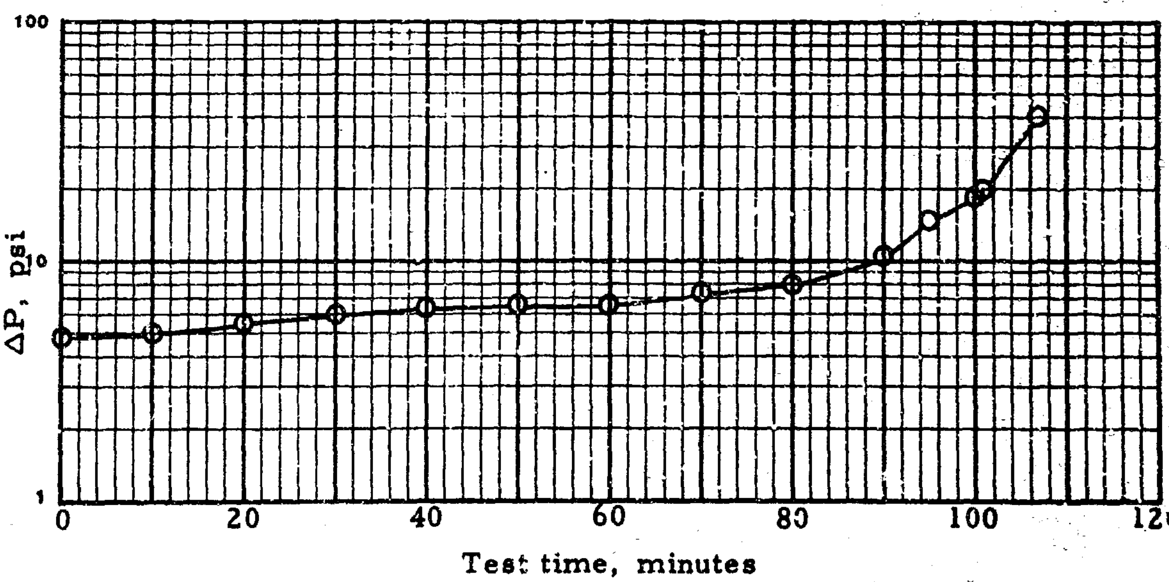


TABLE 36. LOOP TEST NO. 82 Date: 31 May 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Special water (type B synthetic water + NaCl to chloride content of 932 mg/liter) injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.
Test fuel uninhibited JP-5 Batch 16 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 0306720 0.15 vol. %
Corrosion inhibitor None lb/Mbbl

Fuel inlet temperature, °F	75 ± 4	Fuel throughput, gal	2595
Test duration, min	130[a]	Avg. flow rate, gpm	20.0

Actual element weight gain, g 368
Calculated dirt loading, g 400

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.25	0.10	0.0
	WSIM, dist. water	90		
	WSIM, inj. water	78		97
	IFT, dist. water, dyn/cm	43.0		
	IFT, inj. water, dyn/cm	40.8		42.6
	FSII content, vol. %	0.12		0.02
Injection water	Solids, mg/liter		0.0	
	pH		8.35	8.40
	ST, dyn/cm		71.3	72.6
Coalesced water	pH		8.18	8.27[b]
	ST, dyn/cm		54.9	65.0[b]
	FSII content, vol. %		4.40	1.20[b]

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	4	16	1	1	1		1
Cleanup ΔP, psi	0	0	0	0	0		0
Throughput, gal	293	897	1500	2205	2888		2888

a. Test terminated at 130 min with 33 psi pressure drop.

b.

Minutes	5	30	60	95
Coalesced water pH	8.10	8.18	8.23	8.27
Coalesced water ST	57.1	54.9	62.8	65.0
Coalesced water % FSII	5.40	4.40	1.80	1.20

TABLE 36. LOOP TEST NO. 82 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	5.7			0[a]
10	5.7			0
20	6.0			0
30	6.2	0.05	0-1	0
40	6.3			0
50[b]	6.3			0
60	6.3			0
70	6.5			0
80	7.0			0
90	8.0			0
95	8.5	0.02	0-1	0[c]
100	9.0			0
110	12.0			0
120	15.1			0
125	20.0	0.02	0-1	0
130	33.0	Neg.		0

a. Totamitor reading 1 at 1 minute due to passage of water which may occur prior to the build-up of a water layer barrier at the bottom of test housing.
b. Mixing screen plugged; shut down for cleaning.
c. Totamitor reading 2 at 93 mi

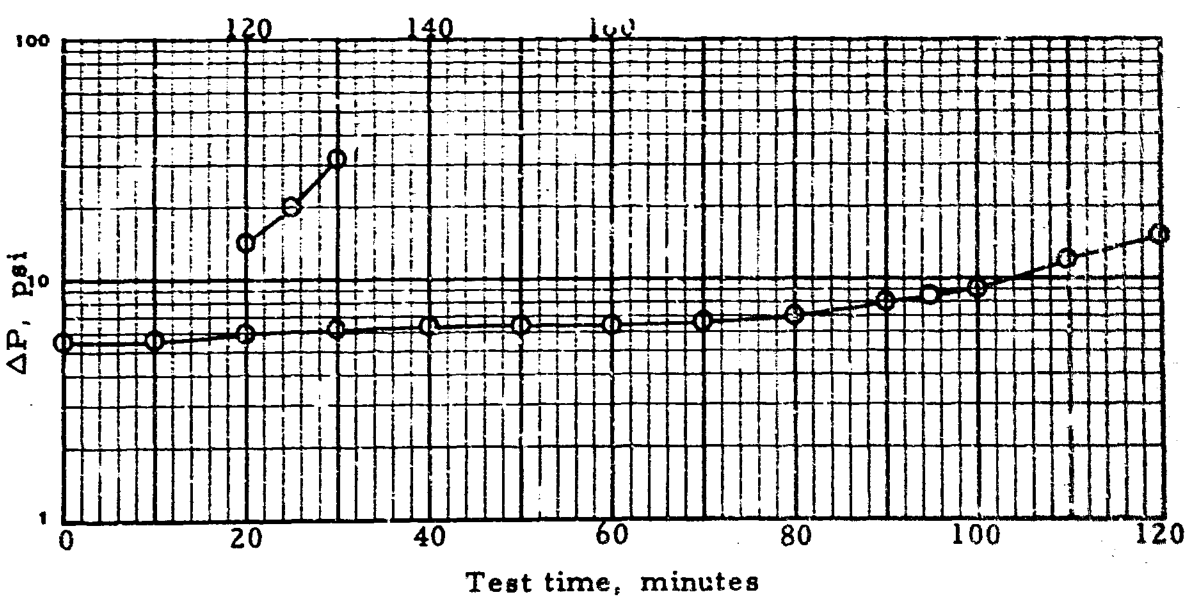


TABLE 37. LOOP TEST NO. 83 Date: 1 June 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 286).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Special water (type B synthetic water + NaCl to chloride content of 932 mg/liter) injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.
Test fuel uninhibited JP-5 Batch 16 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 0306720 0.15 vol. %
Corrosion inhibitor, Santolene "C" Lot NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F 75 ± 3 Fuel throughput, gal 2007
Test duration, min 91 Avg. flow rate, gpm 20.0

Actual element weight gain, g 181
Calculated dirt loading, g 177

		Pre-test	30 min	91 min
Influent fuel	Solids, mg/liter	0.27	0.03	0.05
	WSIM, dist. water	80		
	WSIM, inj. water	68		49
	IFT, dist. water, dyn/cm	41.9		
	IFT, inj. water, dyn/cm	20.2		21.4
	FSII content, vol. %	0.13		0.07
Injection water	Solids, mg/liter		0.2	
	pH		8.38	8.45
	ST, dyn/cm		70.2	70.9
Coalesced water	pH		8.00	---[a]
	ST, dyn/cm		58.6	---[a]
	FSII content, vol. %		3.70	---[a]

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	371	969	1569	2188			2188

---

a.

Minutes	5	30	60	Post-test
Coalesced water pH	7.95	8.00	8.00	8.01
Coalesced water ST	57.6	58.6	63.9	57.4
Coalseced water % FSII	5.40	3.70	2.40	2.00

TABLE 37 . LOOP TEST NO. 83 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	5.0			0[a]
5	5.3			0
10	5.4			0
20	5.5			0
30	5.7	0.12	0-1	0
40	6.0			0
50	6.0			0
60	6.0			0
70	6.9			0
80	12.0			0
87	20.0	0.04	0-1	0
90	34.0			0
91	40.0	0.04	0-1	0
95	50+	0.01	0-1	0

a. Totamitor reading 1 at 1 minute due to passage of water which may occur prior to the build-up of water layer barrier at the bottom of test housing.

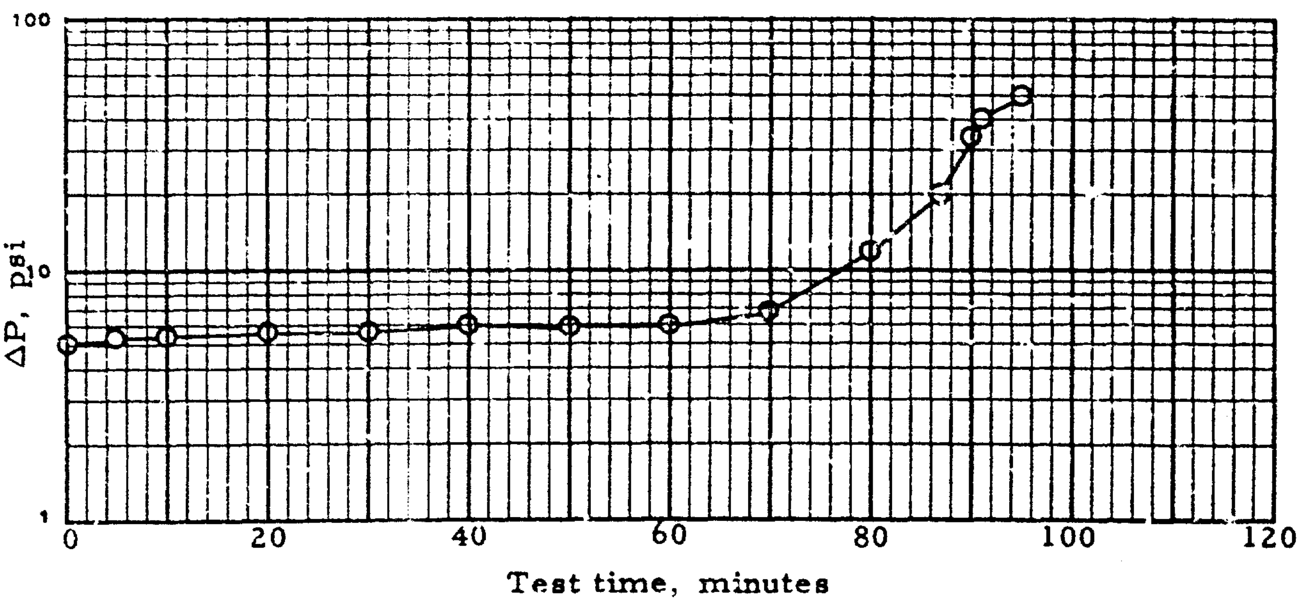


TABLE 38. SINGLE-ELEMENT LOOP TEST NO. 84 Date 29 Jun 67

Loop No. 3 (Al/SS). Housing 8" I. D. Aluminum
Element: Filters Inc. I-4208 Lot 428 with DoD canister, type 1

PROCEDURE: Modified MIL-F-8901A inhibited-fuel test (Procedure No. 11)
Fuel flow 20 gpm, fuel inlet temperature 76-78°F, inlet pressure 70 psi
Water injection 0.2 gpm, solids injection 5.72 g/min starting at 60 min
Test duration 94.8 min, fuel throughput 1929 gal, avg. rate 20.4 gpm

TEST FUEL: JP-5 Batch No. 17, fresh (X) or from preceding test ( )
Anti-icing additive None % (vol.), Dow, Lot
Corrosion inhibitor 16 lb/Mbbl of Santolene "C" Lot NH04-006
Other fuel additives:

Water composition: Standard water No. 1
Solids: Coarse AC dust

ANALYSES:

Clean fuel

WSIM (distilled water)	82 (pre-test)
IFT vs. distilled water, dyn/cm	36.7 (pre-test)
	38.9 (end test)

Injection water, 50 min

Solids, mg/liter	1.1
pH	8.5
Surface tension, dyn/cm	71.4

CALCULATED DIRT LOADING, g	200
ACTUAL ELEMENT WEIGHT GAIN, g	196

	Pre-test	30 min	60 min	End test
Screen ΔP, psi	0	0	0	0
Cleanup ΔP, psi	0	0	0	1
Throughput, gal	311	906	1502	2197

TABLE 38 . SINGLE-ELEMENT LOOP TEST NO. 84 (Cont'd)

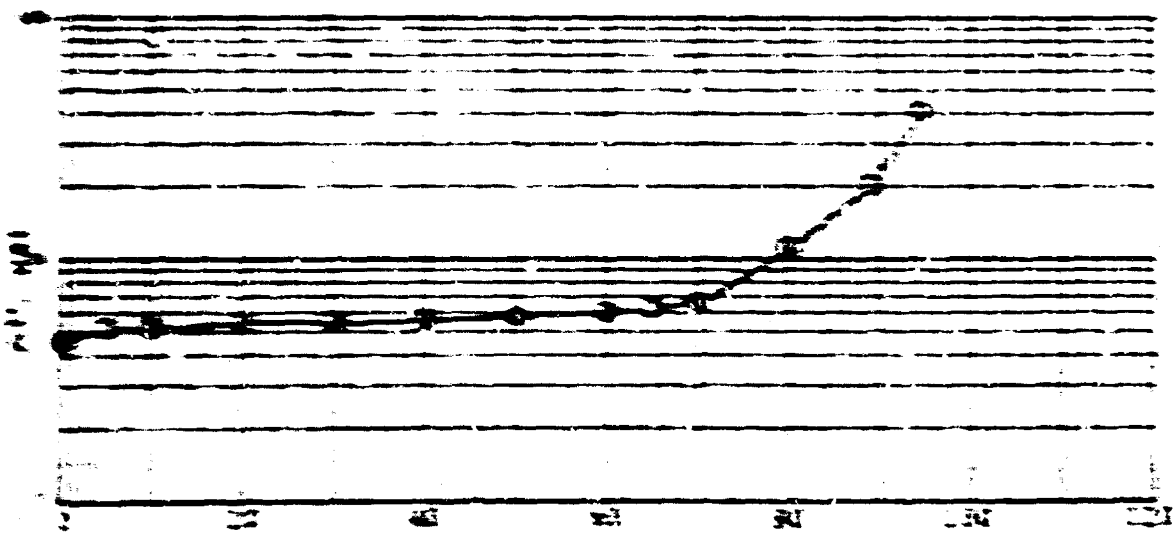
Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent solids, mg/liter	Total water, K-F, mg/liter (a) Clean	Total water, K-F, mg/liter (a) Effl.	Effl. free water, AEL, mg/liter Line samples 500 ml	Effl. free water, AEL, mg/liter Line samples 300 ml	Effl. free water, AEL, mg/liter Bottled samples 500 ml	Effl. free water, AEL, mg/liter Bottled samples 300 ml
0	4.5	0	0(b)							
5	5.1	0	2			79				
10	5.1	0	2			86				
20	5.5	0	1			64				
30	5.5	0	1		79	78				
40	5.7	0	2			69				
50	5.9	0	2			83				
60	6.0	0	0	(c)	79	81				
65	6.2	0	1	Neg.						
70	6.6	0	1	Neg.		74				
80	11.1	0	0	Neg.		86				
89	20.0	0	1	0.4	71	73	3-4	20+	0-1	0-1
94.8	40.0	0	1	1.2	63 (d)	79(c)	0-1	0-1	3-4	0-1

(a) Karl Fischer titrations run with 25-ml fuel sample in 50 ml of 3/5 chloroform/methanol.
(b) Effluent Totamitor reading 2 at 1 min, prior to buildup of water seal in housing.
(c) Accuracy of all solids values questionable because of problems with balance.
(d) Average clean-fuel water content 73 mg/liter; saturation value 71-73 mg/liter (76-78°F).
(e) Special line sample (104-ml bulb) gave 63 mg/liter.

[illegible]

[illegible]		[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]



[illegible]

TABLE 39. SINGLE-ELEMENT LOOP TEST NO. 85 Date 30 Jun 67

Loop No. 3 (Al/SS). Housing 8" I.D. Aluminum
Element: Filters Inc. 1-4298 Lot 428 with DoD canister, type 1

PROCEDURE: Modified MIL-F-8901A inhibited-fuel test (Procedure No. 11)
Fuel flow 20 gpm, fuel inlet temperature 75-77°F, inlet pressure 70 psi
Water injection 0.2 gpm, solids injection 5.72 g/min starting at 60 min
Test duration 91.4 min, fuel throughput 1831 gal, avg. rate 20.1 gpm

TEST FUEL: JP-5 Batch No. 17 , fresh (X) or from preceding test ( )
Anti-icing additive None % (vol.), Dow, Lot
Corrosion inhibitor 16 lb/Mbbl of Santolene "C" Lot NH04-006
Other fuel additives:

Water composition: Standard water No. 1
Solids: Coarse AC dust

ANALYSES:

Clean fuel

WSIM (distilled water)	76	(pre-test)
IFT vs. distilled water, dyn/cm	36.0	(pre-test)
	39.8	(end test)

Injection water, 58 min

Solids, mg/liter	0.2
pH	8.5
Surface tension, dyn/cm	70.4

CALCULATED DIRT LOADING, g	179
ACTUAL ELEMENT WEIGHT GAIN, g	172

	Pre-test	30 min	End test
Screen ΔP, psi	0	0	0
Cleanup ΔP, psi	0	0	0
Throughput, gal	367	1506	2138

TABLE 39 . SINGLE-ELEMENT LOOP TEST NO. 85 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent solids, mg/liter	(a) Total water, K-F, mg/liter Clean	(a) Total water, K-F, mg/liter Effl.	Effl. free water, AEL, mg/liter Line samples 500 ml	Effl. free water, AEL, mg/liter Line samples 300 ml	Effl. free water, AEL, mg/liter Bottled samples 500 ml	Effl. free water, AEL, mg/liter Bottled samples 300 ml
0	4.2	0	0(b)							
5	4.9	0	2			72				
10	5.0	0	2			66				
20	5.4	0	2			69				
30	5.6	0	2		73	92				
40	5.8	0	2			95				
50	6.1	0	1			80				
60	6.4	0	1	(c)	65	70				
65	6.5	0	1	Neg.						
70	7.1	0	1	0.0		76				
80	13.8	0	1	Neg.		74				
85.4	20.0	0	1	Neg.	65	67	3-4	0-1	0-1	0-1
89.3	30.0	0	3-4	2.4	82	76	5-6	1-2	0-1	1-2
91.4	40.0	0	2	0.3	76 (d)	77(e)	7-8	3-4(f)	0-1	0-1

(a) Karl Fischer titrations run with 25-ml fuel sample in 50 ml of 3/5 chloroform/methanol.
(b) Effluent Totamitor reading 2 at 1 min, prior to buildup of water seal in housing.
(c) Accuracy of all solids values questionable because of problems with balance.
(d) Average clean-fuel water content 72 mg/liter; saturation value 70-72 mg/liter (75-77°F).
(e) Special line sample (104-ml bulb) gave 52 mg/liter.
(f) Pad showed several spots that would rate 20+.

TABLE 39. LOOP TEST NO. 85 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

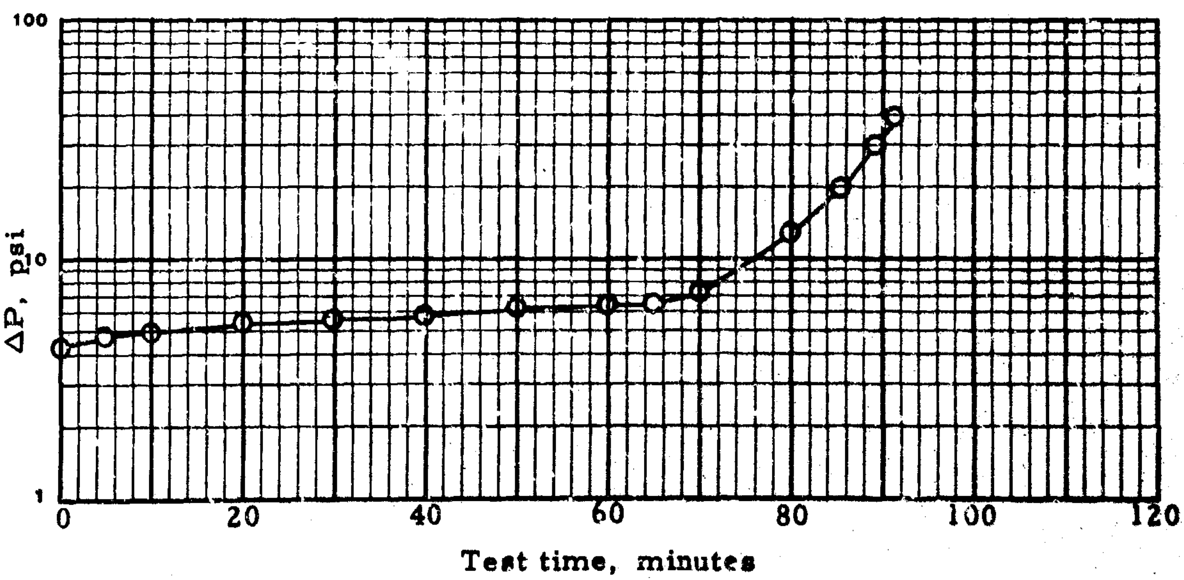


TABLE 40. SINGLE-ELEMENT LOOP TEST NO 86 Date 3 Jul 67

Loop No. 3 (Al/SS), Housing 8" I. D. Aluminum
Element: Filters Inc. I-4208 Lot 428 with DoD canister, type 1

PROCEDURE: Modified MIL-F-8901A inhibited-fuel test (Procedure No. 11)
Fuel flow 20 gpm, fuel inlet temperature 75-78°F, inlet pressure 70 psi
Water injection 0.2 gpm, solids injection 5.72 g/min starting at 60 min
Test duration 89.3 min, fuel throughput 1734 gal, avg. rate 19.5 gpm

TEST FUEL: JP-5 Batch No. 17, fresh (X) or from preceding test ( )
Anti-icing additive None % (vol.), Dow, Lot
Corrosion inhibitor 16 lb/Mbbl of Santolene "C" Lot NH04-006
Other fuel additives:

Water composition: Standard water No. 1
Solids: Coarse AC dust

ANALYSES:

Clean fuel

WSIM (distilled water)	57	(pre-test)
IFT vs. distilled water, dyn/cm	38.5	(pre-test)
	41.1	(end test)

Injection water, 50 min

Solids, mg/liter	0.1
pH	8.3
Surface tension, dyn/cm	71.9

CALCULATED DIRT LOADING, g 168

ACTUAL ELEMENT WEIGHT GAIN, g 156

	Pre-test	30 min	60 min	End test
Screen ΔP, psi	0	0	0	0
Cleanup ΔP, psi	0	0	0	0
Throughput, gal	321	921	1520	2055

TABLE 40 . SINGLE-ELEMENT LOOP TEST NO. 86 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent solids, mg/liter	Total water, K-F, mg/liter (a) Clean	Total water, K-F, mg/liter (a) Effl.	Effl. free water, AEL, mg/liter: Line samples 500 ml	Line samples 300 ml	Bottled samples 500 ml	Bottled samples 300 ml
0	4.1	0	0(b)							
5	4.9	0	1			90	2-3			
10	5.0	0	2			84	5-6			
20	5.2	0	3	(c)		86				
30	5.4	0	3	Neg.	72	78(e)	8-9	2-3	2-3	2-3
40	5.4	0	3			71				
50	5.4	1	3			72				
60	5.5	1	2		78	77				
65	5.6	1	1	Neg.						
70	6.6	1	1	0.1		74				
80	14.0	2	1	0.1		78				
83.9	20.0	2	1	0.2	78	69	2-3	0-1	0-1	0 1
89.3	40.0	2	16		69 (d)	84	10-12(f)	8-10	5-6	5-6

(a) Karl Fischer titrations run with 25-ml fuel sample in 50 ml of 3/5 chloroform/methanol.
(b) Effluent Totamitor reading 1 at 1 min, prior to buildup of water seal in housing.
(c) Accuracy of all solids values questionable because of problems with balance.
(d) Average clean-fuel water content 74 mg/liter; saturation value 70-73 mg/liter (75-78°F).
(e) Special line sample (50-ml syringe) gave 62 mg/liter.
(f) Pad spotted with areas greater than 20 rating.

TABLE 40. LOOP TEST NO. 86 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

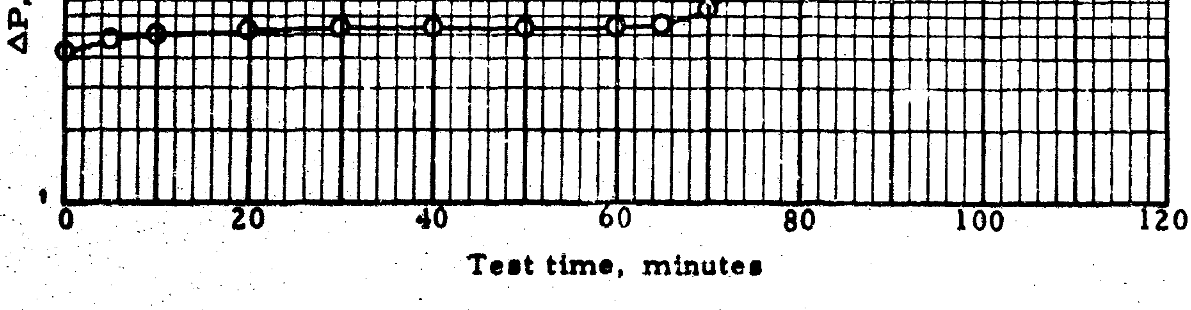


TABLE 41. SINGLE-ELEMENT LOOP TEST NO. 87 Date 6 Jul 67

Loop No. 3 (Al/SS). Housing 8" I. D. Aluminum
Element: Filters Inc. I-4208 Lot 428 with DoD canister, type 1

PROCEDURE: Modified MIL-F-8901A RIO-slurry test (Procedure No. 12*)
Fuel flow 20 gpm, fuel inlet temperature 74-77°F, inlet pressure 70 psi
Water injection 0.2*gpm, slurry injection 31.8g/min throughout
Test duration 197 min, fuel throughput 3893 gal, avg. rate 19.7 gpm

TEST FUEL: JP-5 Batch No. 17, fresh (X) or from preceding test ( )
Anti-icing additive None % (vol.), Dow, Lot
Corrosion inhibitor None lb/Mbbl of Lot
Other fuel additives:

Water composition: Standard water No. 1
Solids: Red iron oxide as slurry (9.09% RIO); solids injection rate 2.89 g/min

ANALYSES:

Injection water, 50 min:

Solids mg/liter	0.2
pH	8.2
Surface tension, dyn/cm	72.2

CALCULATED DIRT LOADING, g 569
ACTUAL ELEMENT WEIGHT GAIN, g 514

	Pre-test	30 min	60 min	94 min	130 min	160 min	End test
Screen ΔP, psi	0	0	0	0	0	0	0
Cleanup ΔP, psi	1	0	0	0	0	0	1
Throughput, gal	335	932	1535	2210	2931	3535	4228

REMARKS
* Test invalid because water injection rate set at 0.2 gpm (1%) instead of 0.6 gpm (3%) as required by test procedure. Results reported for information.

TABLE 41 . SINGLE-ELEMENT LOOP TEST NO. 87 (Cont'd)

Time, min	ΔP, psi	Totamiter Infl.	Totamiter Effl.	Effluent solids, mg/liter	Total water, K-F, mg/liter (a) Clear	Total water, K-F, mg/liter (a) Effl.	Effl. free water, AEL, mg/liter Line samples 500 ml	Line samples 300 ml	Bottled samples 500 ml	Bottled samples 300 ml
0	3.9	0	0							
5	4.5	0	0	0.1		73				
10	5.0	0	0	0.3		67				
20	5.5	0	0	0.5		78				
30	5.6	0	0	0.0	77	69				
40	6.2	0	0	0.1		83				
50	6.6	0	0	0.1		80				
60	7.0	0	0	0.3	79	85				
70	8.3	0	0	Neg.		69				
80	8.6	0	0							
90	9.5	0	0							
94	10.0	0	1	0.2	80	75	1-2	0	0-1	0-1
100	10.5	0	1							
110	11.5	0	1							
120	12.6	0	1							
130	14.1	1	1							
140	15.9	1	1							
150	17.3	2	1							
157	20.0	2	1	0.1	83	85	1-2	0-1	0-1	0
170	24.8	2	1							
182	30.0	3	1	0.0	93	78	0-1	0-1	0	0
190	34.5	3	1							
197	40.0	3	1	0.1	75 (b)	86(c)	0	0	0-1	0

(a) Karl Fischer titrations run with 25-ml fuel sample in 50 ml of 3/5 chloroform/methanol.
(b) Average clean-fuel water content 81 mg/liter; saturation value 69-72 mg/liter (74-77°F).
(c) Special line sample (104-ml bulb) gave 61 mg/liter.

TABLE 41 . LOOP TEST NO. 87 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

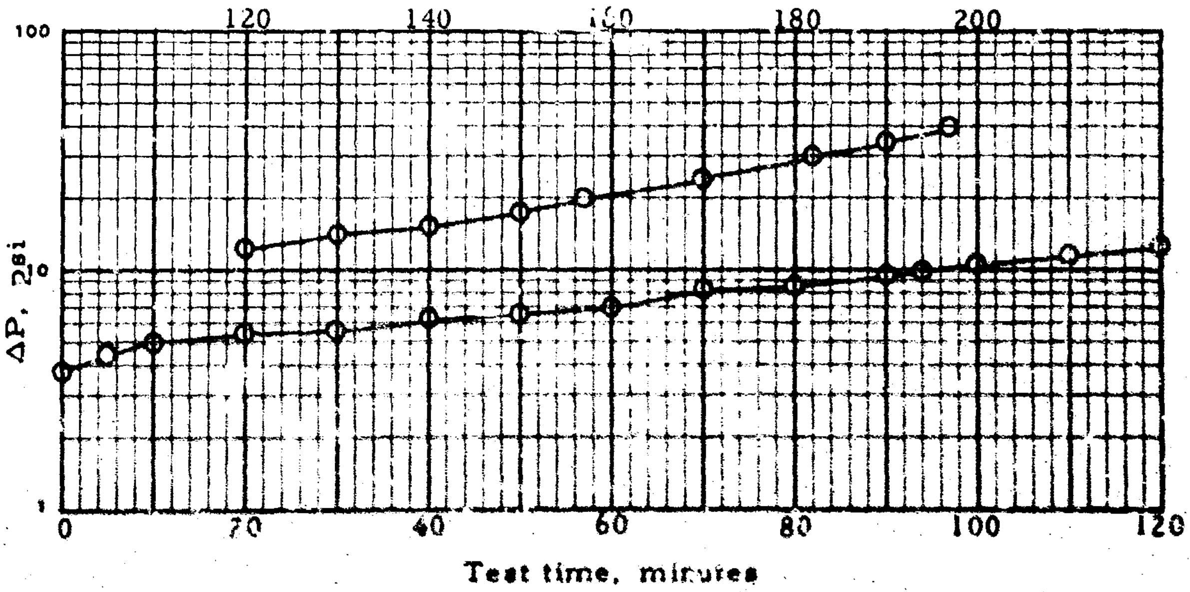


TABLE 42. SINGLE-ELEMENT LOOP TEST NO. 88 Date 12 Jul 67

Loop No. 3 (Al/SS), Housing 8" I. D. Aluminum
Element: Filters Inc. I-4208 Lot 428 with DoD canister, type 1

PROCEDURE: Modified MIL-F-8901A RIO-slurry test (Procedure No. 12)
Fuel flow 20 gpm, fuel inlet temperature 79-80°F, inlet pressure 70 psi
Water injection 0.6 gpm, slurry injection 31.8 g/min throughout
Test duration 85 min, fuel throughput 1708 gal, avg. rate 20.1 gpm

TEST FUEL: JP-5 Batch No. 17 , fresh (X) or from preceding test ( )
Anti-icing additive None % (vol.), Dow, Lot
Corrosion inhibitor None lb/Mbbl of Lot
Other fuel additives:

Water composition: Standard water No. 1
Solids: Red iron oxide as slurry (9.09% RIO); solids injection rate 2.89 g/min

ANALYSES:

Injection water, 50 min:

Solids, mg/liter	0.1
pH	8.3
Surface tension, dyn/cm	73.2

CALCULATED DIRT LOADING, g	245
ACTUAL ELEMENT WEIGHT GAIN, g	261

	Pre-test	30 min	60 min	End test
Screen ΔP, psi	0	0	0	0
Cleanup ΔP, psi	0	0	0	0
Throughput, gal	279	901	1497	1987

TABLE 42. SINGLE-ELEMENT LOOP TEST NO. 88 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent solids, mg/liter	Total water, K-F, mg/liter (a) Clean	Total water, K-F, mg/liter (a) Effl.	Effl. free water, AEL, mg/liter: Line samples 500 ml	Line samples 300 ml	Bottled samples 500 ml	Bottled samples 300 ml
0	4.0	0	0							
5	5.2	0	1	Neg.		66				
10	5.5	0	1	0.1		85				
20	6.9	0	1	0.1		78				
30	8.9	0	1	0.7	74	80				
34	10.0	0	2	0.3	69	67	2-3	1-2	0	0
40	12.0	0	1	0.3		78(d)				
50	15.4	0	2(b)	0.6		72				
57	20.0	0	5	0.4	77	69	13-14	4-5	5-6	2-3
60	21.6	0	8	0.3	72	78				
70	27.0	0	16	0.2		101				
73	30.0	0	46	0.2	82	128	20+	14-16	20+	20+
80	34.4	0	32							
85	40.0	0	37	0.2	82 (c)	93	20+	20+	20+	20+

(a) Karl Fischer titrations run with 50-ml fuel sample in 50 ml of 3/1 chloroform/methanol.
(b) Effluent Totamitor readings and cloudy appearance of effluent samples after 51 minutes indicated continuous passage of contaminants; influent Totamitor readings and clear appearance of all "clean-fuel" samples indicated complete removal of contaminants by cleanup F/S.
(c) Average clean-fuel water content 76 mg/liter; saturation value 74-75 mg/liter (79-80°F).
(d) Special line sample (50-ml syringe) gave 76 mg/liter.

TABLE 42. LOOP TEST NO. 88 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water mg/liter	Totamitor Reading

See preceding page

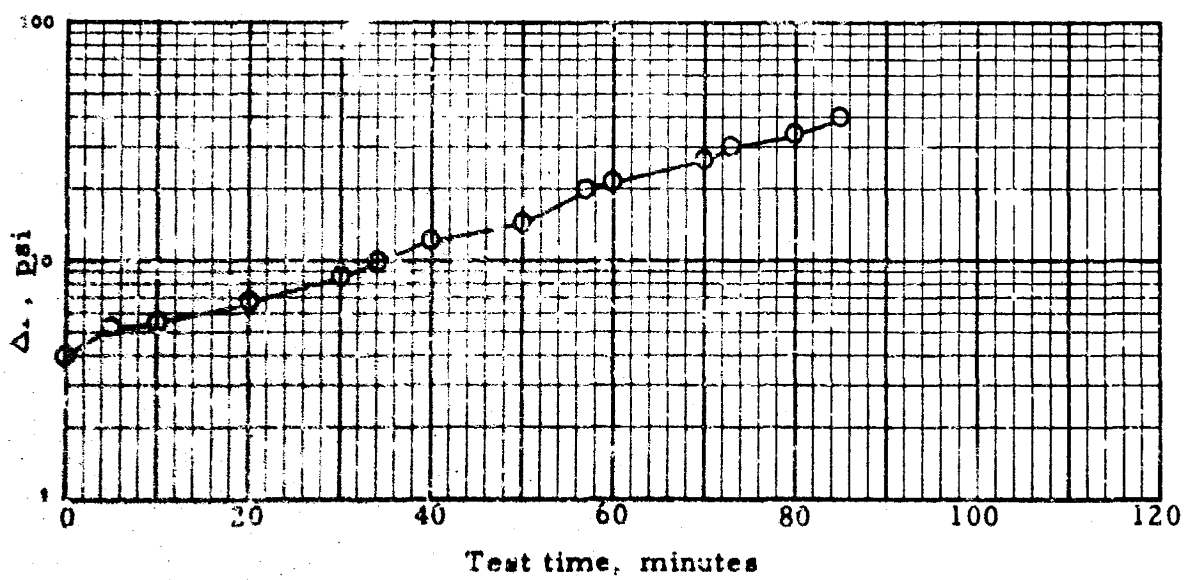


TABLE 43 . SINGLE-ELEMENT LOOP TEST NO 89 Date 13 Jul 67

Loop No. 3 (Al/SS). Housing 8" I. D. Aluminum
Element: Filters Inc. I-4208 Lot 428 with DoD canister, type I

PROCEDURE: Modified MIL-F-8901A RIO-slurry test (Procedure No. 12)
Fuel flow 20 gpm, fuel inlet temperature 78-80°F, inlet pressure 70 psi
Water injection 0.6 gpm, slurry injection 31.8 g/min throughout
Test duration 92 min, fuel throughput 1842 gal, avg. rate 20.0 gpm

TEST FUEL: JP-5 Batch No. 17 , fresh ( ) or from preceding test (X)
Anti-icing additive None % (vol.), Dow, Lot
Corrosion inhibitor None lb/Mbbl of Lot
Other fuel additives:

Water composition: Standard water No. 1
Solids: Red iron oxide as slurry (9.09% RIO); solids injection rate 2.89 g/min.

ANALYSES:

Injection water, 50 min:

Solids, mg/liter	0.0
pH	8.3
Surface tension, dyn/cm	71.6

CALCULATED DIRT LOADING, g	266
ACTUAL ELEMENT WEIGHT GAIN, g	325

	Pre-test	30 min	60 min	End test
Screen ΔP, psi	0	0	0	0
Cleanup ΔP, psi	0	0	1	0
Throughput, gal	309	912	1509	2151

TABLE 43. SINGLE-ELEMENT LOOP TEST NO. 89 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent solids, mg/liter	Total water, K-F, mg/liter (a) Clean	Total water, K-F, mg/liter (a) Effl.	Effl. free water, AEL, mg/liter Line samples 500 ml	Line samples 300 ml	Bottled samples 500 ml	Bottled samples 300 ml
0	4.5	0	0							
5	6.0	0	1	0.1		72				
10	6.6	0	1	0.1		71				
20	7.1	0	1	0.2		76				
28	10.0	0	2	0.0	80	79	4-5	2-3	0-1	0
30	10.2	0	2	0.0	75	74				
40	12.8	0	1	Neg.		73(d)				
50	16.1	0	1	0.1		87				
60	20.0	1	3	0.2	69	80	4-5	2-3	1-2	0-1
70	25.5	2	3	0.0		74				
78	30.0	3	4(b)	0.2	79	79	5-6	3-4	2-3	1-2
90	38.0	4	5							
92	40.0	4	5	Neg.	77 (c)	78	2-3	1-2	0-1	0-1

(a) Karl Fischer titrations run with 50-ml fuel sample in 50 ml of 3/1 chloroform/methanol.
(b) Maximum effluent Totamitor reading 6 at 80 minutes.
(c) Average clean-fuel water content 76 mg/liter; saturation value 73-75 mg/liter (78-80°F).
(d) Special line sample (50-ml syringe) gave 64 mg/liter.

TABLE 43. LOOP TEST NO. 69 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

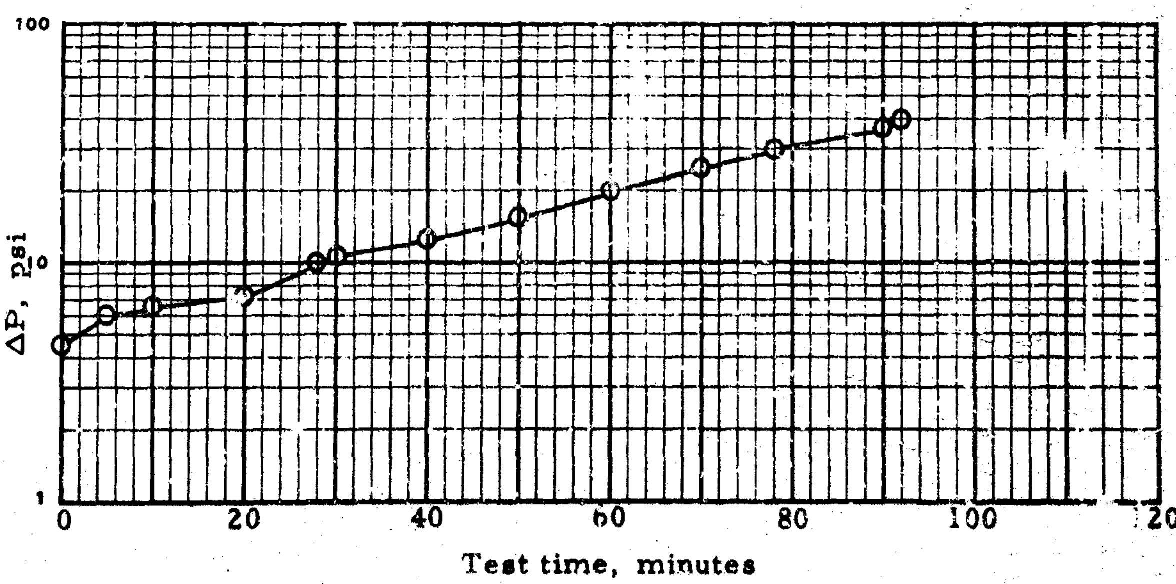


TABLE 44. SINGLE-ELEMENT LOOP TEST NO. 90 Date 17 Jul 67

Loop No. 3 (Al/SS). Housing 3" I. D. Aluminum
Element: Filters Inc. I-4208 Lot 428 with DoD canister, type 1

PROCEDURE: Modified MIL-F-8901A RIO-slurry test (Procedure No. 12)
Fuel flow 20 gpm, fuel inlet temperature 73-76°F, inlet pressure 70 psi
Water injection 0.6 gpm, slurry injection 31.8 g/min throughout
Test duration 132 min, fuel throughput 2655 gal, avg. rate 20.1 gpm

TEST FUEL: JP-5 Batch No. 17, fresh (X) or from preceding test ( )
Anti-icing additive None % (vol.), Dow, Lot
Corrosion inhibitor None lb/Mbbl of Lot
Other fuel additives:

Water composition: Standard water No. 1
Solids: Red iron oxide slurry (9.09% RIO); solids injection rate 2.89 g/min

ANALYSES:

Injection water, 50 min:

Solids, mg/liter	0.3
pH	8.2
Surface tension, dyn/cm	72.0

CALCULATED DIRT LOADING, g	381
ACTUAL ELEMENT WEIGHT GAIN,	360

	Pre-test	30 min	60 min	95 min	130 min	End test
Screen ΔP, psi	0	0	0	0	0	0
Cleanup ΔP, psi	0	0	0	1	0	1
Throughput, gal	299	907	1506	2247	2909	2954

TABLE 44 . SINGLE-ELEMENT LOOP TEST NO. 90 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent solids, mg/liter	Total water, K-F, mg/liter (a) Clean	Total water, K-F, mg/liter (a) Effl.	Effl. free water, AEL, mg/liter Line samples 500 ml	Line samples 300 ml	Bottled samples 500 ml	Bottled samples 300 ml
0	4.5	0	0							
5	5.4	0	0	0.1		68				
10	6.1	0	0	0.1		64				
20	7.5	0	0	0.2		64				
30	9.0	0	0	0.2	66	66				
33	10.0	0	0	0.2	66	62	0	0	0	0
40	11.5	0	1	0.1		69(c)				
50	14.0	0	1	0.0		66				
60	17.4	0	1	0.2	66	69				
67	20.0	0	1	0.1	68	66	0	0	0	0
70	21.2	1	1	0.2		70				
80	24.1	2	1							
90	27.5	3	1							
97	30.0	3	1	0.2	67	63	0	0-1	0	0-1
100	30.6	3	1							
110	34.3	4	1							
120	37.3	5	1							
130	39.0	5	1							
132	40.0	5	1	0.2	66 (b)	71	3-4	1-2	0-1	0-1

(a) Karl Fischer titrations run with 50-ml fuel sample in 50 ml of 3/1 chloroform/methanol.
(b) Average clean-fuel water content 66 mg/liter; saturation value 68-71 mg/liter (73-76°F).
(c) Special line sample (50-ml syringe) gave 61 mg/liter.

TABLE 44 . LOOP TEST NO. 90 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

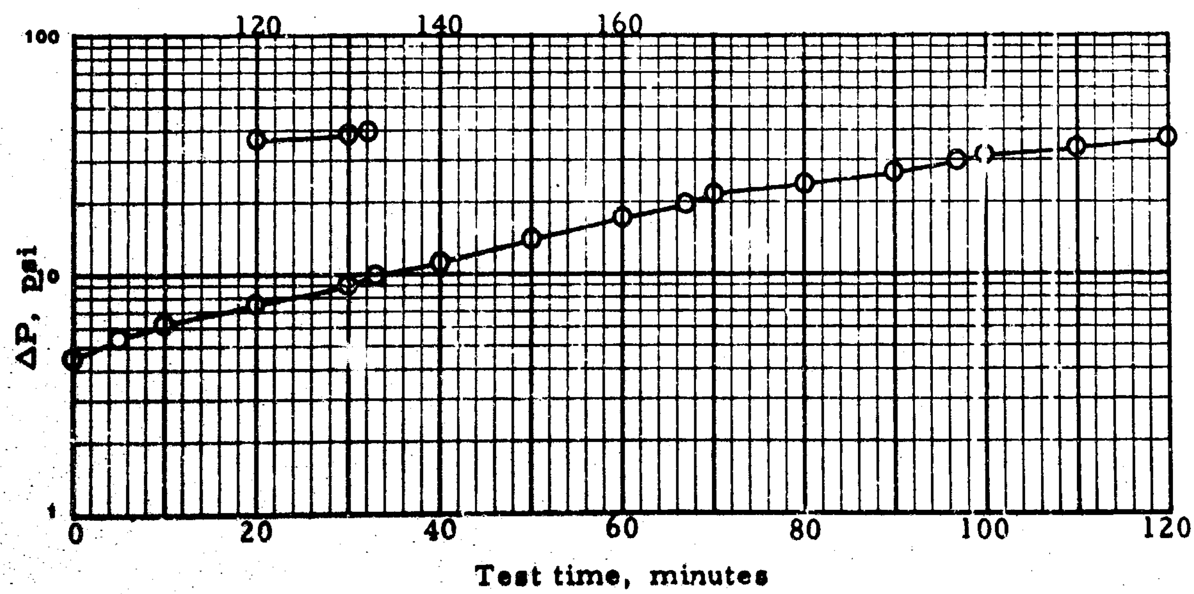


TABLE 45. LOOP TEST NO. 91 — Date: Blended 19 July 1967, Tested 20 July 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 140).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 17 plus additives as shown.

(X) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 0306720	0.15 vol. %
Corrosion inhibitor, Santolene "C" NH04-006	16 lb/Mbbl

Fuel inlet temperature, °F	74-76	Fuel throughput, gal	2082
Test duration, min	104	Avg. flow rate, gpm	20.0

Actual element weight gain, g	241
Calculated dirt loading, g	252

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.49	0.14	0.15
	WSIM, dist. water	70		
	WSIM, inj. water	58		59
	IFT, dist. water, dyn/cm	34.2		
	IFT, inj. water, dyn/cm	16.6		17.0
	FSII content, vol. %	0.13		0.00

		5 min	30 min	60 min	95 min	40 psi
Injection water	Solids, mg/liter		Neg.			
	pH		8.4		3.4	
	ST, dyn/cm		71.9		73.0	
Coalesced water	pH	8.1	8.0	8.0	8.0	8.0
	ST, dyn/cm	49.1	41.0	55.0	56.5	54.7
	FSII content, vol. %	a	a	2.2	1.4	1.2

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0	0.5			0.5
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	335	937	1548	2257			2417

a. Sample too cloudy to run

TABLE 45. LOOP TEST NO. 91 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Rotameter Reading
0	4.4			0
5	4.6			0
10	4.9			0
20	5.1			0
30	5.1	0.19	0-1	0
40	5.2			0
50	5.4			0
60	5.5			0
70	5.6			0
80	8.5			0
90	14.1			0
95	18.2	0.24	0-1	0
96	20.0	0.03	0-1	0
100	26.5			0
104	40+	0.00	3-4	0

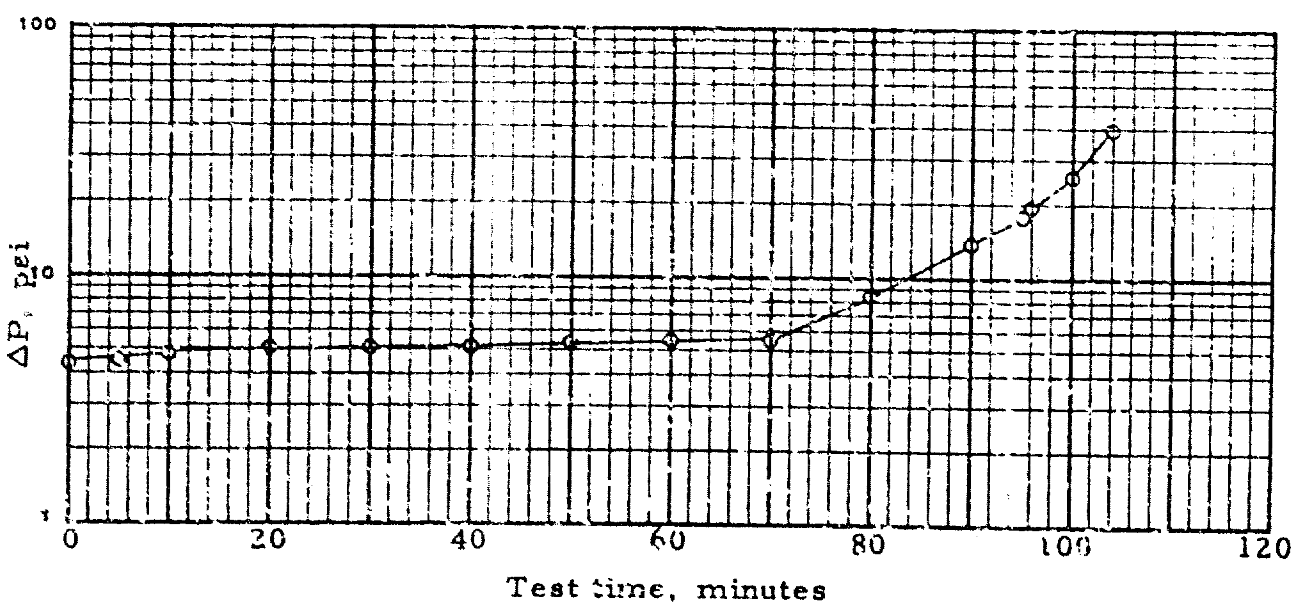


TABLE 46. LOOP TEST NO. 92

Date: Blended 21 July 1967
Tested 21 July 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Special water(type E synthetic water + NaOH to pH 9.5) injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 17 plus additives as shown.

(X) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 0306720	0.15 vol. %
Corrosion inhibitor, Santolene "C" NH04-006	16 lb/Mbbl

Fuel inlet temperatur °F	77-78	Fuel throughput, gal	1966
Test duration, min	98	Avg. flow rate, gpm	20.1

Actual element weight gain, g	192
Calculated dirt loading, g	217

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.39	0.22	0.09
	WSIM, dist. water	83		
	WSIM, inj. water	70		69
	IFT, dist. water, dyn/cm	34.0		
	IFT, inj. water, dyn/cm	18.1		19.0
	FSII content, vol. %	0.11		0.00

		5 min	30 min	60 min	95 min	40 psi
Injection water	Solids, mg/liter		0.0			
	pH		8.8		8.6	
	ST, dyn/cm		68.6		66.6	
Coalesced water	pH	8.1	7.9	8.0	8.0	8.1
	ST, dyn/cm	52.3	52.2	52.4	53.4	52.6
	FSII content, vol. %	5.8	3.6	2.1	1.5	

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	1	0	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	326	932	1526	2226			2292

TABLE 46 . LOOP TEST NO. 92 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.9			0
5	5.9			0
10	6.3			0
20	6.3			0
30	6.5	0.28	2-3	0
40	6.6			0
50	6.6			0
60	6.7			0
70	7.0			0
80	10.6			0
90	17.6			0
92	20.0	0.09	2-3	0
95	27.5	0.06	5-6	0
98	40.0	Neg.	5-6	0

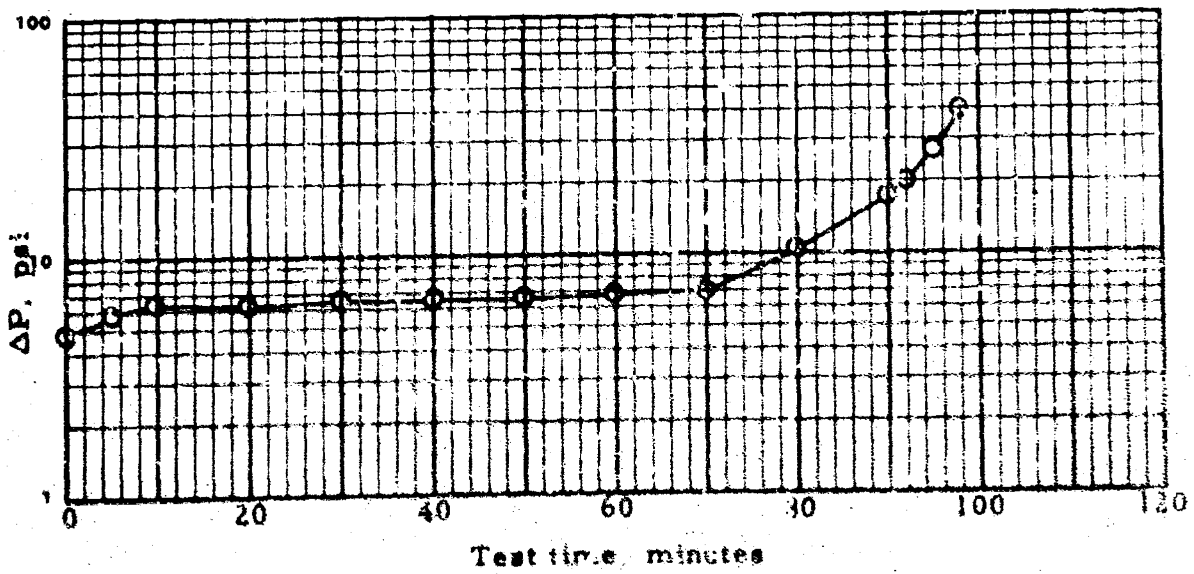


TABLE 47. LOOP TEST NO. 93

Date: Blended 24 July 1967
Tested 25 July 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Distilled water[a] injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 17 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot	0306720	0.15 vol. %
Corrosion inhibitor, Santolene "C"	NH04-006	16 lb/Mbbl

Fuel inlet temperature, °F	77-79	Fuel throughput, gal	1811
Test duration, min	91	Avg. flow rate, gpm	19.9

Actual element weight gain, g	173
Calculated dirt loading, g	177

		Pre-test	30 min	40 psi
Influent fuel	Solids, mg/liter	0.27	0.04	0.00
	WSIM, dist. water	76		
	WSIM, inj. water	57		63
	IFT, dist. water, dyn/cm	36.3		
	IFT, inj. water, dyn/cm	16.1		21.3
	FSII content, vol. %	0.11		0.00

		5 min	30 min	60 min	40 psi
Injection water	Solids, mg/liter		0.1		
	pH		9.6[a]		8.9[a]
	ST, dyn/cm		73.7		73.8
Coalesced water	pH	7.4	7.3	7.8	7.4
	ST, dyn/cm	55.8	56.9	57.7	58.6
	FSII content, vol. %	5.6	3.8	2.1	1.4

Time, min:	Pre-test	30	60	91	130	160	End
Screen ΔP, psi	0	0	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	361	959	1562	2172			2172

a. Water injection system apparently contaminated with residues from Test 92.

TABLE 47. LOOP TEST NO. 93 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.8			0
5	5.6			0
10	5.7			0
20	6.0			0
30	6.3	Neg.	0	0
40	6.3			0
50	6.5			0
60	6.5			0
70	7.4			0
80	13.0			0
86	20.0	0.00	2-3	0
90	34.9			0
91	40.0	0.01	2-3	0

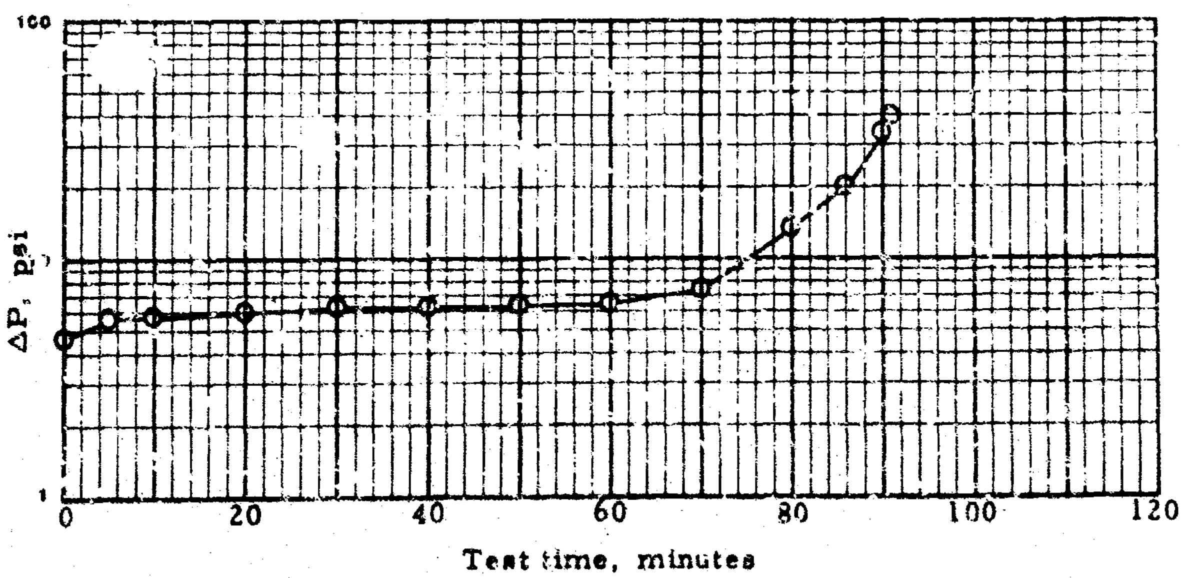


TABLE 48. LOOP TEST NO. 94

Date: Blended 26 July 1967
Tested 27 July 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Distilled water[a] injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 17 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 0306720 0.15 vol. %
Corrosion inhibitor, Santolene "C" NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F	80-81	Fuel throughput, gal	1971
Test duration, min	98	Avg. flow rate, gpm	20.1

Actual element weight gain, g 222
Calculated dirt loading, g 220

			Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter		0.52	0.08	0.14
	WSIM, dist. water		74		
	WSIM, inj. water		77		65
	IFT, dist. water, dyn/cm		32.0		
	IFT, inj. water, dyn/cm		25.4		24.3
	FSII content, vol. %		0.14		0.02

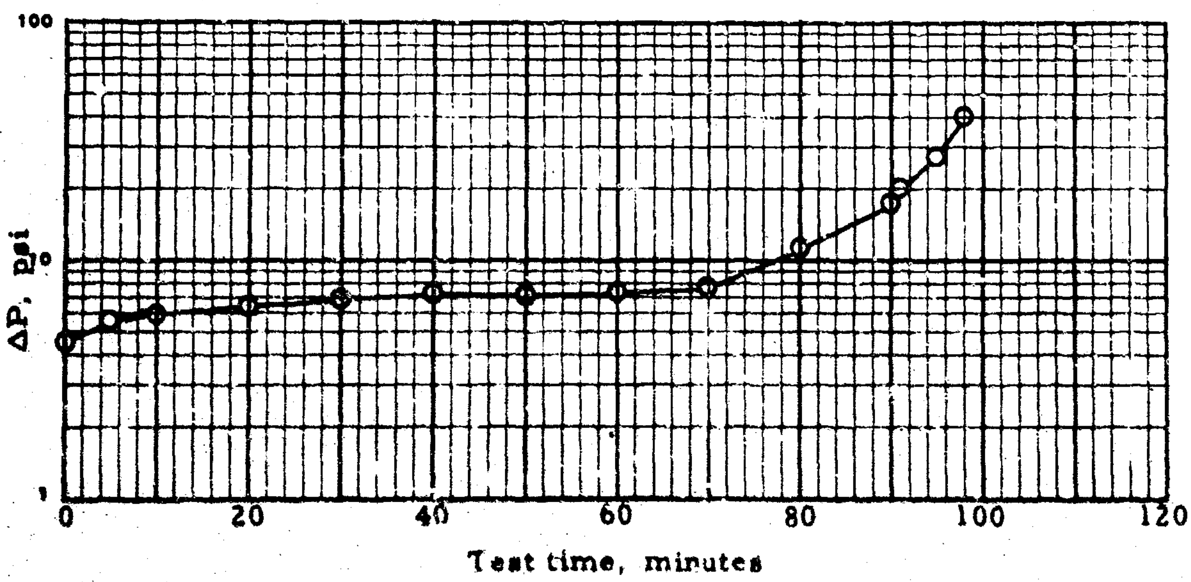
		5 min	30 min	60 min	95 min
Injection water	Solids, mg/liter		Neg.		
	pH		8.9[a]		8.7[a]
	ST, dyn/cm		70.8		70.8
Coalesced water	pH	7.2	6.6	6.7	6.9
	ST, dyn/cm	52.0	58.2	55.1	51.4
	FSII content, vol. %	5.0	2.6	1.4	1.5

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	298	895	1501	2200			2269

a. Water injection system apparently contaminated with residues from Test 92.

TABLE 48. LOOP TEST NO. 94 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.5			0
5	5.7			0
10	6.0			0
20	6.5			0
30	7.0	0.06	1-2	0
40	7.2			0
50	7.1			0
60	7.3			0
70	7.9			0
80	11.0			0
90	18.5			0
91	20.0	0.08	1-2	0
95	28.0	0.00	2-3	0
98	40.0	Neg.	4-5	0



Blended 27 July 1967

TABLE 49. LOOP TEST NO. 95 — Date: Tested 28 July 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Distilled water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 17 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 0306720 — 0.15 vol. %
Corrosion inhibitor, Santolene "C" NH04-006 — 16 lb/Mbbl

Fuel inlet temperature, °F 76-78 — Fuel throughput, gal 1964
Test duration, min 98 — Avg. flow rate, gpm 20.0

Actual element weight gain, g 205
Calculated dirt loading, g 217

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.10	0.14	0.00
	WSIM, dist. water	78		
	WSIM, inj. water	78		84
	IFT, dist. water, dyn/cm	34.6		
	IFT, inj. water, dyn/cm	33.1[a]		34.7[a]
	FSII content, vol. %	0.13		0.01

		5 min	30 min	60 min	95 min	40 psi
Injection water	Solids, mg/liter		0.8			
	pH		7.1		7.2	
	ST, dyn/cm					70.7[a]
Coalesced water	pH	6.6	6.0	6.4	6.8	6.8
	ST, dyn/cm					53.4
	FSII content, vol. %	5.3	3.5	2.2	1.4	1.5

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	297	896	1494	2194			2261

a. Using post-test injection water (pH 7.2).

TABLE 49. LOOP TEST NO. 95 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.4			0
5	5.1			0
10	5.5			0
20	5.9			0
30	5.9	0.11	2-3	0
40	6.0			0
50	6.0			0
60	6.0			0
70	6.5			0
80	8.5			0
90	17.9			0
91	20.0	2.12[a]	2-4	0
95	28.4	0.28	3-4	0
98	40.0	Neg.	3-4	0

a. Metal particles visible on pad.

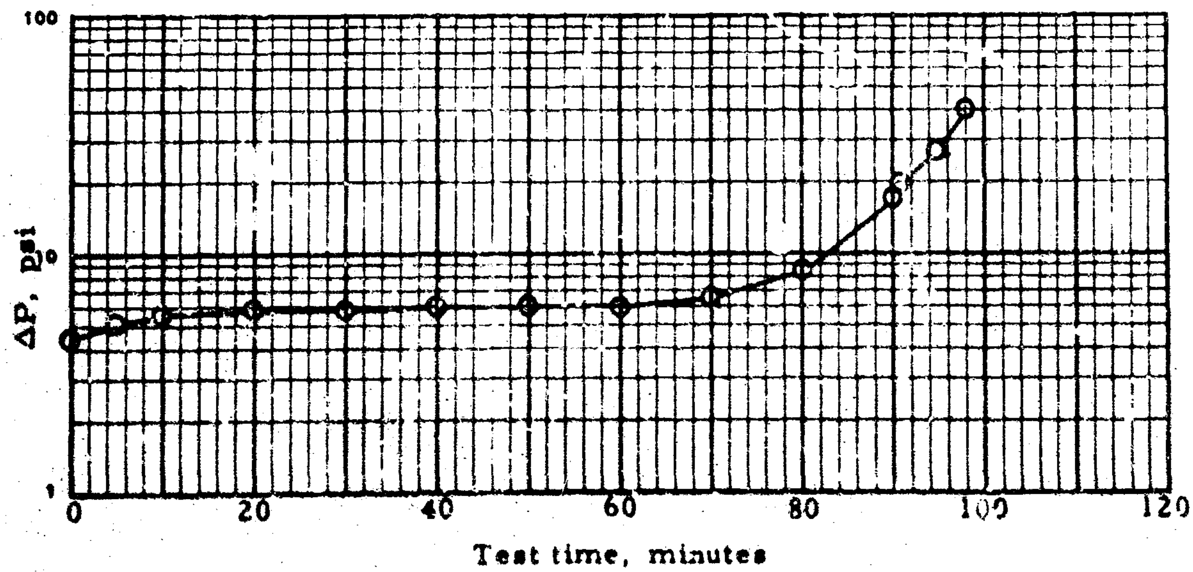


TABLE 50. LOOP TEST NO. 96

Date: Blended 31 July 1967
Tested 1 August 1967

Al/SS loop with 8" I. D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Filtered tap water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 17 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 0306720		0.15 vol. %
Corrosion inhibitor, Santolene "C"	NH04-006	16 lb/Mbbl

Fuel inlet temperature, °F	77-79	Fuel throughput, gal	1693
Test duration, min	85	Avg. flow rate, gpm	20.0

Actual element weight gain, g 141
Calculated dirt loading, g 143

		Pre-test	30 min	40 psi
Influent fuel	Solids, mg/liter	0.28	0.07	0.10
	WSIM, dist. water	76		
	WSIM, inj. water	55		40
	IFT, dist. water, dyn/cm	36.1		
	IFT, inj. water, dyn/cm	18.5		21.2
	FSII content, vol. %	0.13		0.02

		5 min	30 min	60 min	95 min	40 psi
Injection water	Solids, mg/liter		---			
	pH		7.4			7.5
	ST, dyn/cm		71.4			71.8
Coalesced water	pH	8.2	8.1	8.1		8.2
	ST, dyn/cm	56.5	40.5	26.3		27.0
	FSII content, vol. %	5.4	a	a		a

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0				0
Cleanup ΔP, psi	0	0	0				0
Throughput, gal	308	913	1508				2001

a. Sample too cloudy for analysis.

TABLE 50. LOOP TEST NO. 96 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.5			0[a]
5	5.8			0
10	6.5			0
20	7.6			0
30	8.1	0.05	0-1	0
40	8.6			0
50	8.9			0
60	9.3			0
70	11.9			0
78	20.0	0.06	1-2	0
85	40.0	Neg.	2-3	0

a. Effluent Totamitor reading of 1 at 1 minute, prior to build-up of water seal in housing.

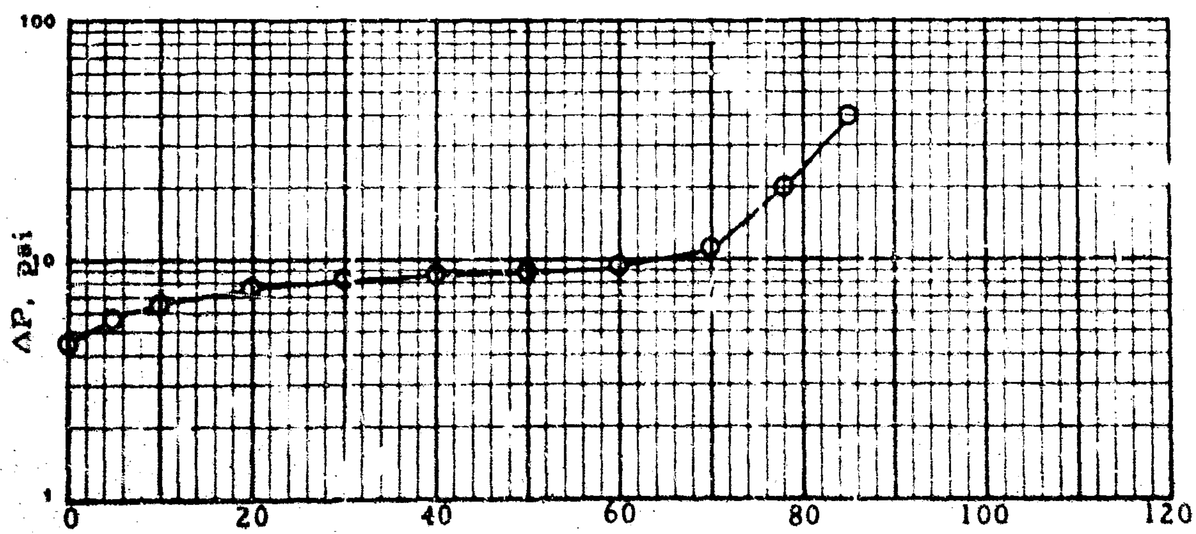


TABLE 51. LOOP TEST NO. 97

Date: Blended 1 August 1967
Tested 2 August 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Special carbonate water[a] injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 17 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 0306720 0.15 vol. %
Corrosion inhibitor, Santolene "C" NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F 78-81
Test duration, min 104
Fuel throughput, gal 2079
Avg. flow rate, gpm 20.0

Actual element weight gain, g 248
Calculated dirt loading, g 252

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.38	0.14	0.01
	WSIM, dist. water	78		
	WSIM, inj. water	78		50
	IFT, dist. water, dyn/cm	35.7		
	IFT, inj. water, dyn/cm	14.0		14.9
	FSII content, vol. %	0.13		0.02

		5 min	30 min	60 min	95 min	40 psi
Injection water	Solids, mg/liter		0.0			
	pH		9.8		9.8	
	ST, dyn/cm		71.9		71.8	
Coalesced water	pH	8.8	9.0	9.2	9.0	8.8
	ST, dyn/cm	50.4	52.4	54.6	54.9	59.3
	FSII content, vol. %	b	b	b	b	b

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	327	927	1527	2231			2406

a. Distilled water + 164 mg/liter $NaHCO_3$ + NaOH to pH 9.5; final blend corresponds to 121 mg/liter $NaHCO_3$ and 55 mg/liter Na_2CO_3.
b. Sample too cloudy for analysis.

TABLE 51. LOOP TEST NO. 97 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.4			0[a]
5	5.2			0
10	5.7			0[b]
20	5.4			0
30	5.6	0.12	0	0[c]
40	5.9			0
50	5.9			0
60	5.9			1
70	6.1			0
80	8.2			0
90	11.7			0
95	16.4	0.04	0-1	0
98	20.0	Neg.	0-2	0
104	40.0	Neg.	3-4	0

a. Effluent Totamitor reading of 2 at 2 minutes, prior to build-up of water seal in housing.

b. Coalesced water layer at bottom of canister drained, giving an effluent Totamitor reading of 4 at 11 minutes.

c. Effluent Totamitor reading of 5 at 36-38 minutes.

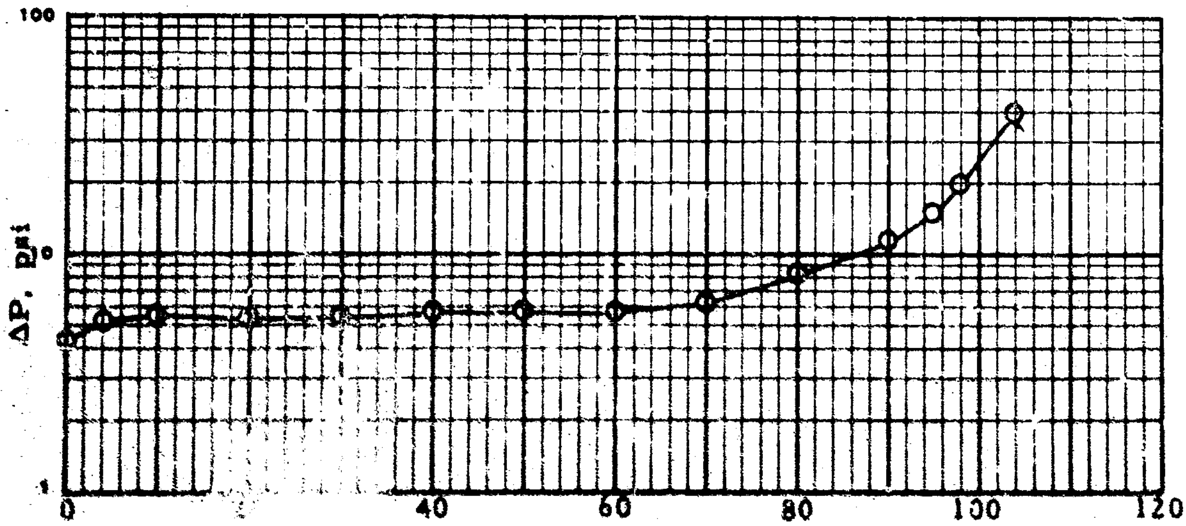


TABLE 52. LOOP TEST NO. 98[a] Date: 3 August 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 17 plus additives as shown.
(X) Fresh fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 0306702 0.15 vol. %
Corrosion inhibitor, Santolene "C" NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F 79-80 Fuel throughput, gal 803
Test duration, min 40[a] Avg. flow rate, gpm 20.1

Actual element weight gain, g ---
Calculated dirt loading, g 0[a]

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.27	0.06	
	WSIM, dist. water	81		
	WSIM, inj. water	63		
	IFT, dist. water, dyn/cm	36.5		
	IFT, inj. water, dyn/cm	18.8		
	FSII content, vol. %	0.13		
Injection water	Solids, mg/liter		0.1	
	pH		7.3	
	ST, dyn/cm		72.1	
		(5min)		
Coalesced water	pH	8.3	8.3	
	ST, dyn/cm	54.2	36.4	
	FSII content, vol. %	5.8	b	

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0					0
Cleanup ΔP, psi	0	0					0
Throughput, gal	299	896					1102

a. Test terminated early because of excessive free water in effluent. Test results INVALID because element had been crushed during installation.
b. Sample too cloudy for analysis.

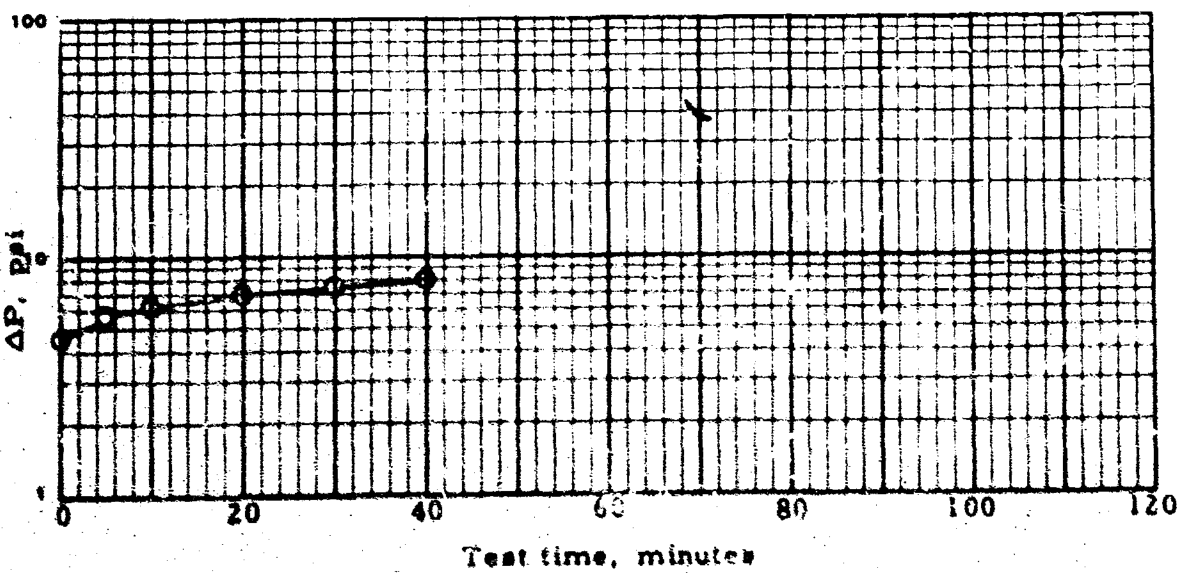
TABLE 52. LOOP TEST NO. 98 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading	Fuel temps. at pump, °F: Inlet	Outlet
0	4.5			0[a]	76	88
5	5.8			15	78	88
10	6.2			32	79	88
20	7.0			73	80	89
30	7.5	0.36[b]	20+[c]	100+	80	89
40	8.0			100+	80	88

a. Totamitor began climbing after 15 seconds test time and continued to climb until it reached 100+ at 30 min.

b. Sample cloudy.

c. Two consecutive AEL's read 20+.



Blended 3 August 1967

TABLE 53. LOOP TEST NO. 99 Date: Tested 4 August 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Filtered tap water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 17 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 0306720 0.15 vol. %
Corrosion inhibitor, Santolene "C" NH04-006 16 lb/Mbbl

Fuel inlet temperature, °F 79-80 Fuel throughput, gal 2175
Test duration, min 109 Avg. flow rate, gpm 19.8

Actual element weight gain, g 248
Calculated dirt loading, g 280

		(5 min)	(60 min)	Pre-test	30 min	100 min
Influent fuel	Solids, mg/liter			0.35	0.05	Neg.
	WSIM, dist. water			68		
	WSIM, inj. water			64		50
	IFT, dist. water, dyn/cm			36.3		
	IFT, inj. water, dyn/cm			17.4		20.9
	FSII content, vol. %			0.13		0.02
Injection water	Solids, mg/liter				Neg.	
	pH				7.3	7.3
	ST, dyn/cm				73.0	72.4
Coalesced water	pH	8.3	8.2		8.2	8.2
	ST, dyn/cm	58.3	a		a	a
	FSII content, vol. %	6.0	b		b	b

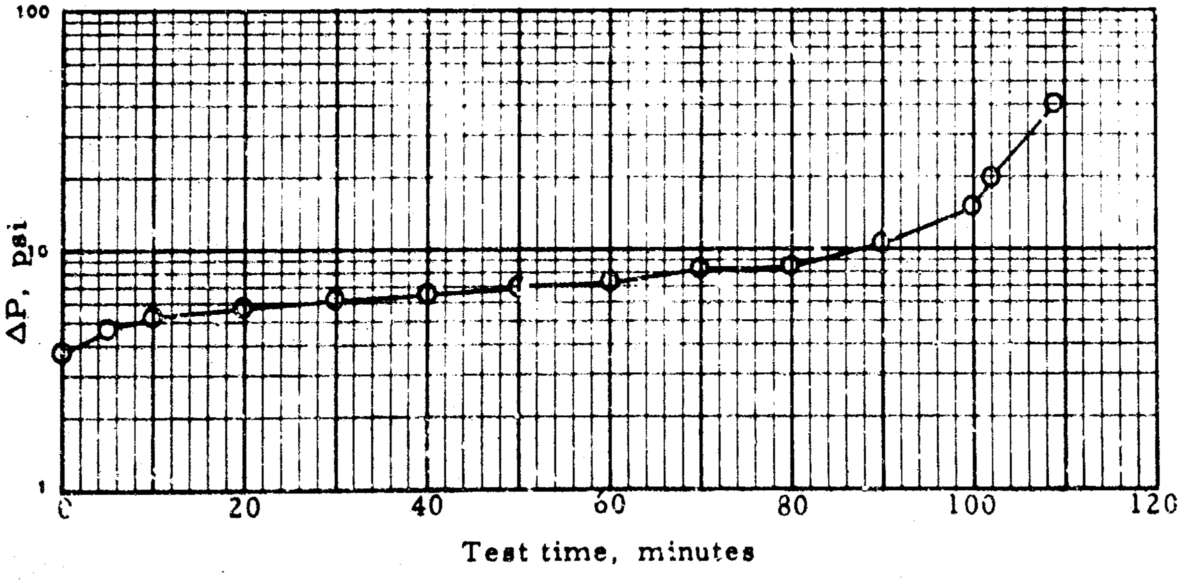
Time, min:	Pre-test	30	60	100	130	160	End
Screen ΔP, psi	0	0	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	296	896	1495	2289			2471

a. Sample emulsified with fuel; no analysis possible.
b. Sample too cloudy for analysis.

TABLE 53. LOOP TEST NO. 99 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading	Fuel temps. at pump, °F: Inlet	Outlet
0	3.9			0[a]	76	89
5	4.9			0	76	89
10	5.2			0	77	89
20	5.9			0	78	89
30	6.1	Neg.	0-2	0	79	89
40	6.6			0	79	88
50	7.0			0	79	88
60	7.2			0	79	88
70	8.1			0	80	88
80	8.6			0	80	88
90	10.5			0	80	88
100	16.5	0.03	8-10	0	80	88
102	20.0	0.05	3-4	0	80	88
109	40.0	Neg.	7-9	0	80	88

a. Totamitor reading of 1 at 2 minutes due to passage of water droplets before water seal could be formed at bottom of canister.



Blended 8 August 1967

TABLE 54. LOOP TEST NO. 100 Date: Tested 9 August 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 18 plus additives as shown.

(X) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot	0306720	0.15 vol. %
Corrosion inhibitor, AFA-1 Lot 37		16 lb/Mbbl

Fuel inlet temperature, °F	80	Fuel throughput, gal	2628
Test duration, min	132	Avg. flow rate, gpm	20.0

Actual element weight gain, g	366
Calculated dirt loading, g	412

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.39	0.05	0.05
	WSIM, dist. water	59		
	WSIM, inj. water	65		73
	IFT, dist. water, dyn/cm	22.7		
	IFT, inj. water, dyn/cm	23.1		23.9
	FSII content, vol. %	0.14		0.02
Injection water	Solids, mg/liter		0.4	
	pH		8.2	8.2
	ST, dyn/cm		70.5	70.5
Coalesced water	pH		7.3	7.5
	ST, dyn/cm		40.8	40.1
	FSII content, vol. %		3.3	1.2

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0	0	0		0
Cleanup ΔP, psi	0	0	0	0	0		0
Throughput, gal	298	895	1502	2196	2895		2926

TABLE 54. LOOP TEST NO.100 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading	Fuel temps. at pump, °F: Inlet	Outlet
0	4.0			0[a]	77	89
10	5.1			0	77	89
20	5.4			0	77	89
30	5.4	0.07	1-3	0	77	89
40	5.5			0	77	89
50	5.6			0	78	89
60	5.6			0	78	89
70	6.0			0	78	89
80	6.4			0	78	89
90	7.3			0	78	89
95	8.0	0.07	0-2	0	78	89
100	8.4			0	78	89
110	10.3			0	78	89
120	14.8			0	78	89
124	20.0	0.05	4-6	0	78	89
130	32.5	0.12	7-9	0	78	89
132	40.0	b	7-9	0	78	89

a. Effluent Totamitor reading of 1 at 1 minute due to passage of water droplets before a proper water layer could be formed at bottom of canister.

b. Mercury found in port sampling valve; "brass" colored solids on pad gave an analysis of 8.04 mg/liter.

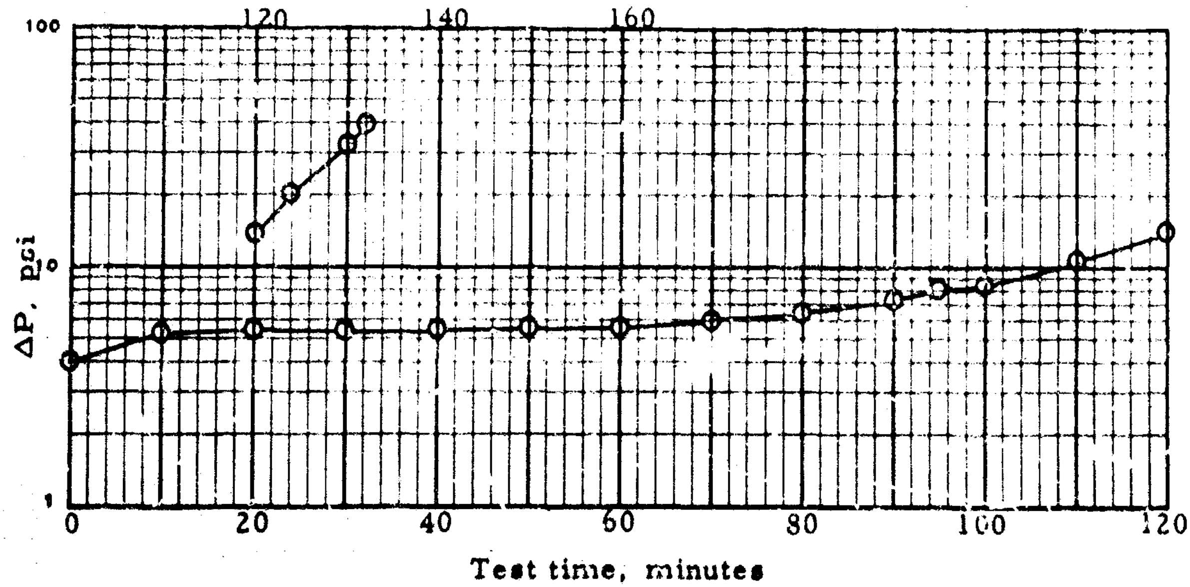


TABLE 55 . SINGLE-ELEMENT LOOP TEST NO. 101 Date: 11 Aug 67

Loop no. 3 (Al/SS)

Housing: 8" I. D. aluminum
Element: Filters Inc. I-4208 Lot 440
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water
Solids: Coarse AC dust

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 10 Aug 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1 , Lot 37

Test duration, min	60	Calculated dirt loading, g	257
Fuel throughput, gal	1201	Actual element weight gain, g	238
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	301	1502
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	61
IFT, distilled water, dyn/cm	23.2

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.3
ST, dyn/cm	71.9

TABLE 55 . SINGLE-ELEMENT LOOP TEST NO. 101 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.6	0	0			82
5	3.9	0	0	0.30	0	
10	4.2	0	0			
15	4.5	0	0			80
20	5.4	0	0			
25	6.9	0	0			
30	8.5	0	0			80
35	11.5	0	0			
40	17.5	0	0			
42	20.0	0	0	0.07	0-2	
46	21.4	0	0	0.07	0-2	80
52	21.5	0	0		1-3	
56	22.0	0	1		1-3	81
60	40.0	0	1	0.23	4-6	79

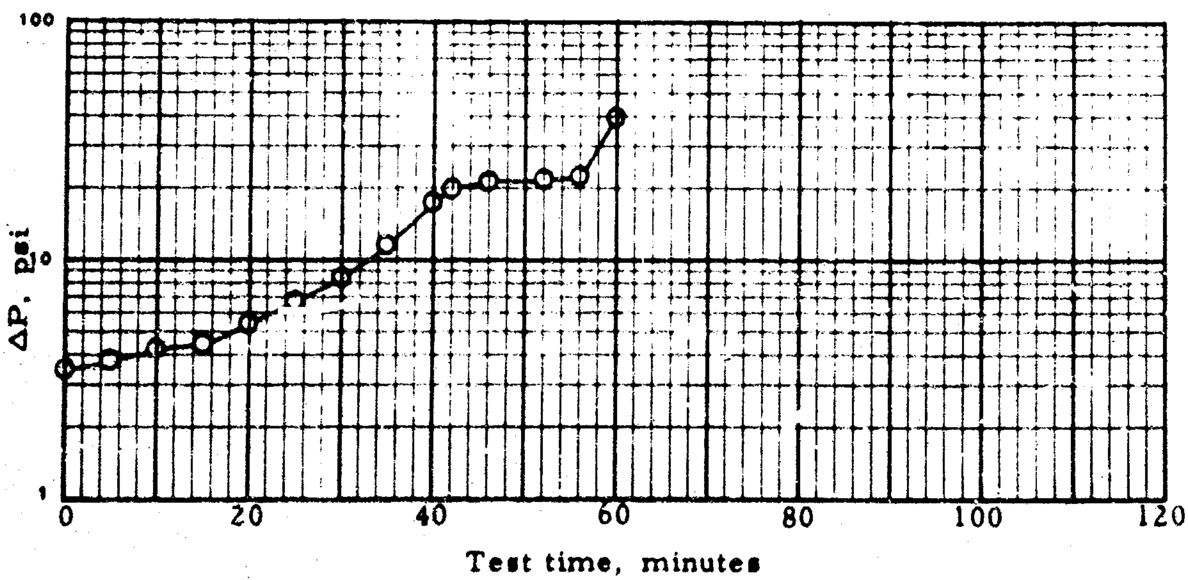


TABLE 56 . SINGLE-ELEMENT LOOP TEST NO. 102 Date: 14 Aug 67

Loop no. 3 (Al/SS)	Housing: 8" I. D. aluminum
	Element: Filters Inc. I-4208 Lot 440
	Canister: DoD type i

Procedure no.	13-B	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Coarse AC dust	Fuel inlet pressure, psi	70

Water injection schedule: No water until ΔP 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 14 Aug 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1 . Lot 37

Test duration, min	62	Calculated dirt loading, g	263
Fuel throughput, gal	1203	Actual element weight gain, g	246
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	323	1526
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	55
IFT, distilled water, dyn/cm	23.4

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.4
ST, dyn/cm	72.1

TABLE 56 . SINGLE-ELEMENT LOOP TEST NO. 102 (Cont'd)

Time, min	ΔP, psi	Rotameter Infl.	Rotameter Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.9	0	0			80
5	4.0	0	0	0.43	0	
10	4.0	0	0			
15	4.0	0	1			80
20	4.4	0	1			
25	5.0	0	1			
30	7.5	0	2			81
35	10.0	0	2			
40	17.0	0	2			
43	20.0	0	2	3.17(a)	0-1	80
48	23.0	0	2	0.17	4-6	
53	22.4	0	2		6-8	
58	27.5	0	3		6-8	
61	40.0	0	4	0.22	14-16	82

(a) Brown solids on pad.

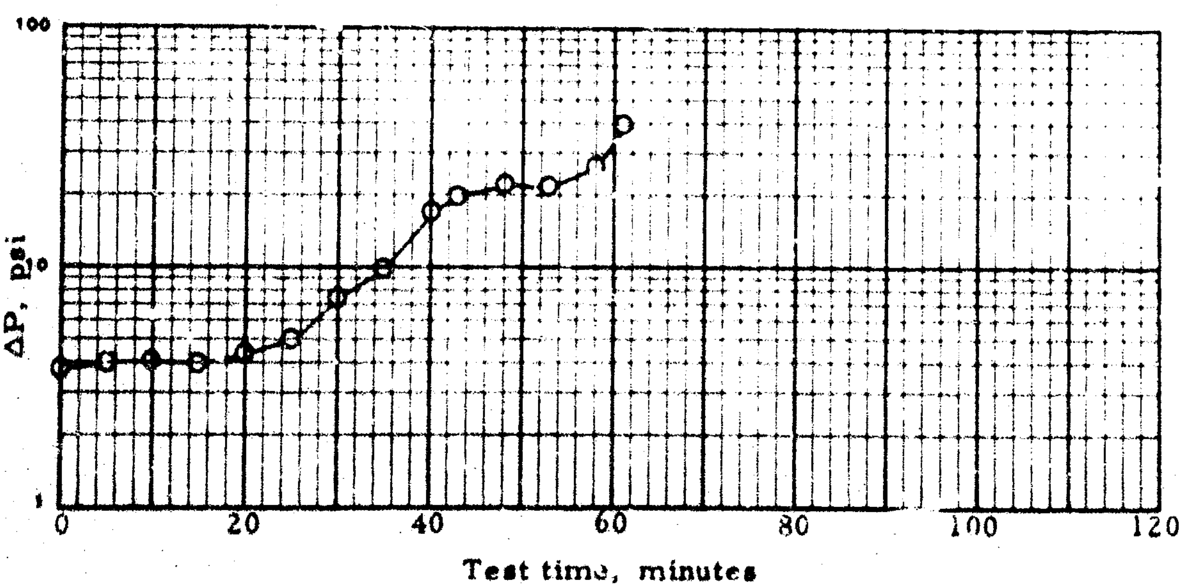


TABLE 57 . SINGLE-ELEMENT LOOP TEST NO. 103 Date: 14 Aug 67

Loop no. 3 (Al/SS)		Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD type 1

Procedure no. 13-C	Fuel flow, gpm	20
Water: Filtered tap water	Fuel inlet temperature, °F	80
Solids: Coarse AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.6 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 14 Aug 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1 , Lot 37

Test duration, min	48	Calculated dirt loading, g	189
Fuel throughput, gal	949	Actual element weight gain, g	186
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	298	1247
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:	Pre-test
Time	63
WSIM, distilled water	23.6
IFT, distilled water, dyn/cm	

Analyses on injection water:	
Time	Post-test
Solids, mg/liter	0.2
pH	7.3
ST, dyn/cm	72.2

TABLE 57 . SINGLE-ELEMENT LOOP TEST NO. 103 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.6	0	0			78
5	4.6	0	1	0.08	0	
10	5.2	0	1			
15	7.5	0	1			78
20	10.5	0	1			
25	12.5	0	1			
30	18.0	0	1			80
31	20.0	0	1	0.44	1-2	
36	25.7	0	1	0.04	10-12	
41	26.4	0	1		8-10	
46	26.2	0	2		8-10	80
48	40.0	0	3	0.32	8-10	80

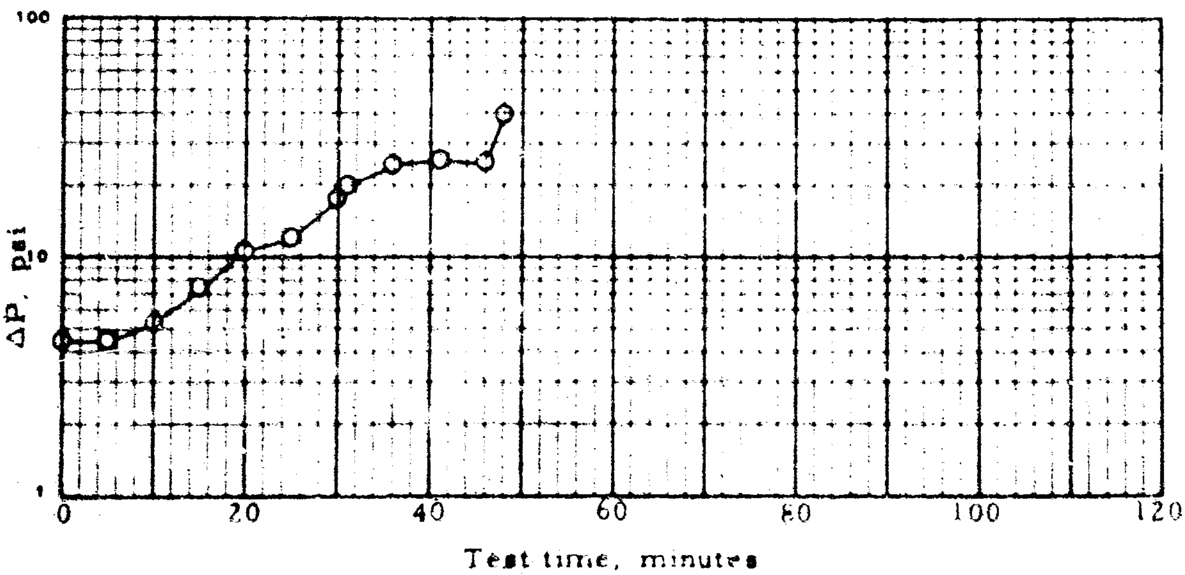


TABLE 58 . SINGLE-ELEMENT LOOP TEST NO. 104 Date: 15-16 Aug 67

Loop no. 3 (Al/SS)

Housing: 8" I. D. aluminum
Element: Filters Inc. 1-4208 Lot 440
Canister: DoD type 1

Procedure no. 13-D
Water: Filtered tap water
Solids: Coarse AC dust

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm to 20 psi, then discontinued for 8 hr of fuel-only operation and 8-hr shutdown. After restart, water 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min to 20 psi, then discontinued for 8 hr of fuel-only operation and 8-hr shutdown. After restart, solids 5.72 g/min to end of test.

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 15 Aug 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1 , Lot 37

Test duration, min	558	Calculated dirt loading, g	274
Fuel throughput, gal	11,124	Actual element weight gain, g	264
Average rate, gpm	19.9		

Time	0 min	521 min	536 min	End test
Meter reading, gal	298	10,717	297	705
Screen ΔP, psi	0		(reset)	1
Cleanup ΔP, psi	0			0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	69
IFT, distilled water, dyn/cm	23.6

Analyses on injection water:

Time	20 psi	Post-test
Solids, mg/liter	0.0	0.2
pH	7.3	7.4
ST, dyn/cm	72.2	72.1

TABLE 58 . SINGLE-ELEMENT LOOP TEST NO. 104 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
	Water (0.002 gpm) and solids injection started					
0	4.1	0	0			80
5	5.4	0	1	0.35	0	
10	4.7	0	1			
15	4.9	0	1			80
20	5.5	0	1			
25	7.2	0	1			
30	9.2	0	1			80
35	12.5	0	1			
40	18.5	0	1			
41	20.0	0	1			
	Water and solids injection discontinued					
45	17.5	0	0			80
60	16.4	0	0			80
120	15.2	0	0			80
180	15.1	0	0			80
240	14.9	0	0			80
300	15.1	0	0			80
360	15.0	0	0			80
420	15.0	0	0			80
480	15.0	0	0			80
521	15.0	0	0	0.14	3-4	80
	Shut down for 8 hours					
526	6.6	0	0			
531	6.4	0	0			
536	6.3	0	0	0.10	3-4	80
	Water injection started (0.2 gpm)					
541	9.0	0	(a)	Neg.	3-4	
546	9.6	0	0		2-3	
551	10.5	0	0		2-3	80
	Water continued, solids injection started					
556	28.5	0	0			
558	40.0	0	0	0.20	3-4	80

(a) Effluent Totamitor reading of 2 at 537 min, before buildup of water seal in bottom of housing.

TABLE 58. LOOP TEST NO. 104 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

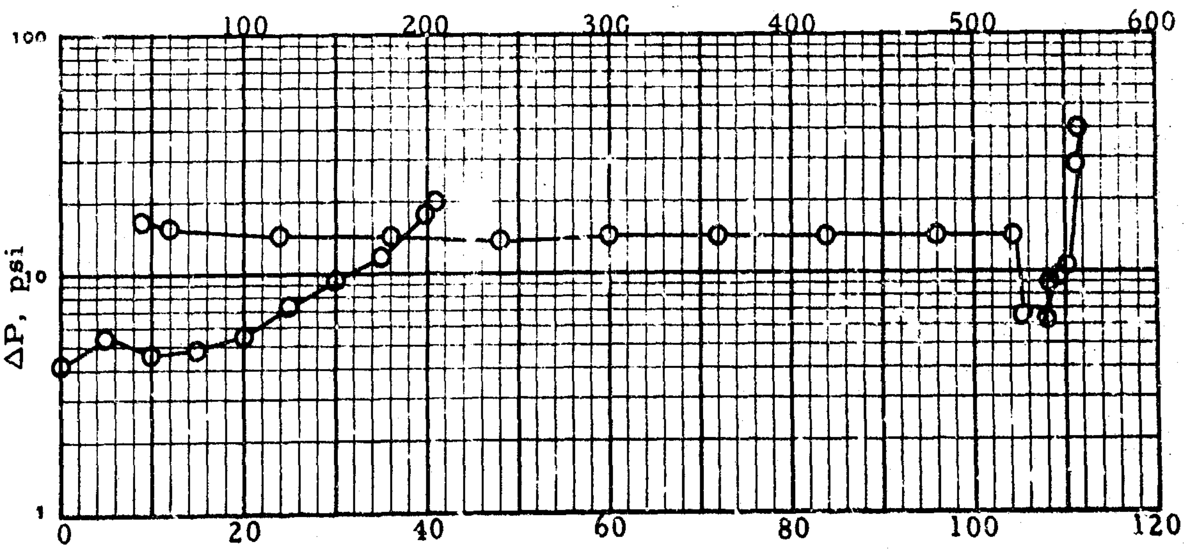


TABLE 59. SINGLE-ELEMENT LOOP TEST NO. 105 Date: 16 Aug 67

Loop no. 3 (Al/SS)		Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD type 1

Procedure no. 13-E	Fuel flow, gpm	20
Water: Filtered tap water	Fuel inlet temperature, °F	80
Solids: Red iron oxide (I-116)	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 gpm to end of test.

Test fuel JP-5 batch no. 18, fresh
Date blended with additives: 16 Aug 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1, Lot 37

Test duration, min	58[a]	Calculated dirt loading, g	332
Fuel throughput, gal	1155	Actual element weight gain, g	250
Average rate, gpm	19.9		

Time	0 min	End test
Meter reading, gal	332	1487
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test	End test
WSIM, distilled water	62	Solids=0.34 mg/liter
IFT, distilled water, dyn/cm	23.4	

Analyses on injection water

Time	Post-test
Solids, mg/liter	0.3
pH	7.3
ST, dyn/cm	72.2

(a) Terminated early because of severe passage of solids into effluent fuel. Since ΔP did not reach 20 psi, the scheduled changes in solids and water injection were not made; entire test was run with 5.72 g/min solids injection and 0.002 gpm water injection.

TABLE 59. SINGLE-ELEMENT LOOP TEST NO. 105 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.1	0	0[a]			80
5	4.3	0	32	1.06	0[a]	
10	4.5	1	38			
15	4.6	3	56			80
20	5.1	6	61			
25	5.4	7	64			
30	5.7	9	67			80
35	6.2	11	67			
40	6.6	13	67			
45	7.5	14	66			80
50	8.5	18	56			
55	9.2	21	56			
58	9.5	23	54	23.19	0[b]	80

(a) Totamitor began recording high reading immediately upon injection.
(b) RIO visible on AEL pad.

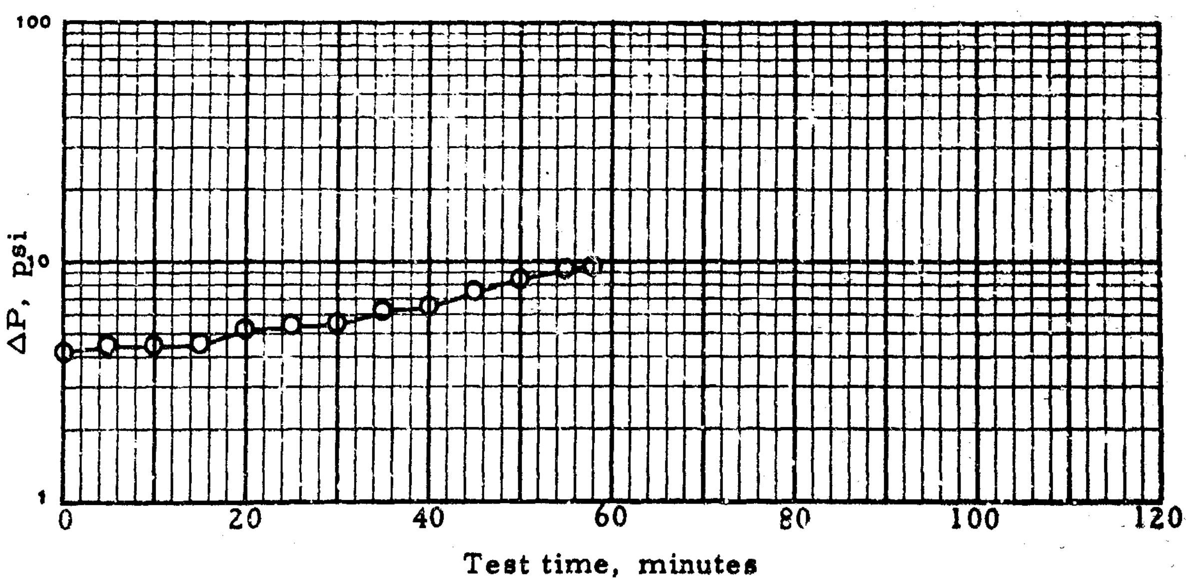


TABLE 60 . SINGLE-ELEMENT LOOP TEST NO. 106 Date: 21 Aug 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD type 1

Procedure no. 13-F		Fuel flow, gpm	20
Water: Filtered tap water		Fuel inlet temperature, °F	80
Solids: Coarse AC dust		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 1.43 g/min from 0 min to 20 psi, then discontinued 15 min, then 1.43 g/min to end of test.

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 21 Aug 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1 , Lot 37

Test duration, min	155	Calculated dirt loading, g	200
Fuel throughput, gal	3107	Actual element weight gain, g	219
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	326	3433
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	61
IFT, distilled water, dyn/cm	23.5

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.2
ST, dyn/cm	72.2

TABLE 60 . SINGLE-ELEMENT LOOP TEST NO. 106 (Cont'd)

Time, min	ΔP, psi	Totamiter Infl.	Totamiter Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.0	0	0			80
5	4.5	0	0	0.03		
10	4.8	0	0			
15	4.8	0	0			80
20	5.0	0	0			
25	5.0	0	0			
30	5.0	0	0			80
35	5.2	0	0			
40	5.3	0	0			
45	5.5	0	0			80
50	6.0	0	0			
55	6.5	0	0			
60	7.0	0	0			80
65	7.5	0	0			
70	8.0	0	0			
75	8.6	0	0			81
80	9.1	0	0			
85	10.0	0	0			
90	10.7	0	0			81
95	11.6	0	0			
100	12.1	0	0			
105	14.0	0	0			80
110	15.4	0	0			
115	16.7	0	0			
120	17.9	0	0			80
125	20.0	0	0	0.03	2-3	
130	22.0	0	0	0.06	2-3	
135	20.5	0	0		1-2	80
140	20.6	0	0		1-2	
145	27.2	0	0			
150	32.1	0	0			80
155	40.0	0	0	0.05	5-7	80

TABLE 60. LOOP TEST NO. 106 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

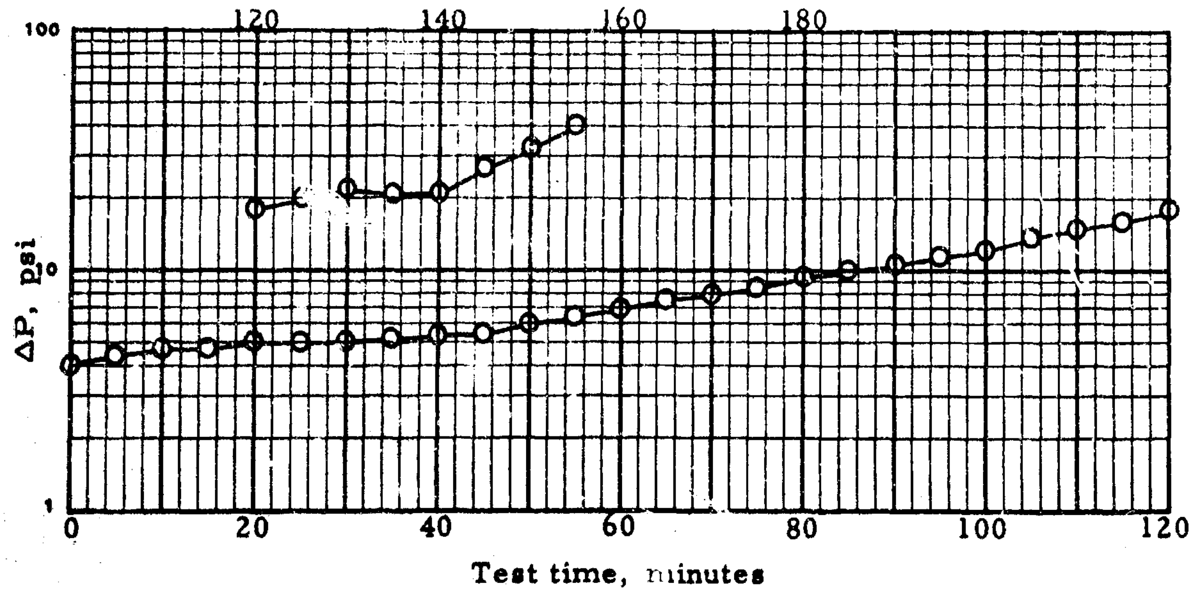


TABLE 61 . SINGLE-ELEMENT LOOP TEST NO. 107 Date: 22 Aug 67

Loop no. 3 (Al/SS)

Housing: Transparent
Element: Filters Inc. I-4208 Lot 440[a]
Canister: None (screen built into housing)

Procedure no. 13-A modified[a]
Water: Filtered tap water
Solids: Coarse AC dust

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 to 20 min, then 0.2 gpm for several min.

Solids injection schedule: 5.72 g/min 0 min, to end.

Test fuel JP-5 batch no. 18 , re-used from previous test
Date blended with additives: 21 Aug 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1 , Lot 37

Test duration, min
Fuel throughput, gal
Average rate, gpm

Calculated dirt loading, g
Actual element weight gain, g

Time
Meter reading, gal
Screen ΔP, psi
Cleanup ΔP, psi

Analyses on influent fuel:
Time
WSIM, distilled water
IFT, distilled water, dyn/cm

Analyses on injection water:
Time
Solids, mg/liter
pH
ST, dyn/cm

(a) Special test with cutaway element; visual observations only.

TABLE 62 . SINGLE-ELEMENT LOOP TEST NO. 108 Date: 24-25 Aug 67

Loop no. 3 (Al/SS)

Housing: 8" I. D. aluminum
Element: Filters Inc. I-4208 Lot 440
Canister: DoD type 1

Procedure no. 14
Water: Filtered tap water
Solids: Coarse AC dust

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm throughout first 5 cycles; 0.2 gpm throughout sixth cycle[a].

Solids injection schedule: In each of first 5 cycles, 5.72 g/min from start to 20 psi; in sixth cycle, 5.72 g/min from start to termination (40 psi)[a].

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 23 Aug 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1 , Lot 37

Test duration, min 1202
Fuel throughput, gal 24218
Average rate, gpm 20.1

Calculated dirt loading, g 242
Actual element weight gain, g 219

Time[b]	Cycle 1		Cycle 2		Cycle 3		Cycle 4		Cycle 5		Cycle 6	
Meter reading, gal	316	5120	0	4781	0	4810	0	4787	0	4804	0	233
Screen ΔP, psi	1	1	1	1	0	1	1	1	1	0	0	0
Cleanup ΔP, psi	0	1	0	1	0	1	3	1	1	2	2	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	54
IFT, distilled water, dyn/cm	23.5

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.9
ST, dyn/cm	72.2

(a) Test consists of five 4-hr cycles with a minimum of 10 min shutdown between cycles, then a sixth cycle consisting of water and solids injection until test is terminated at 40 psi.

(b) Meter readings and ΔP's refer to start and end of cycle.

TABLE 62 . SINGLE-ELEMENT LOOP TEST NO. 108 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
Cycle 1:						
0	4.5	0	0			81
5	4.6	0	0	3.26[a]	0-1	
10	5.0	0	0			
15	5.6	0	0			82
20	8.3	0	0			
25	11.1	0	0			
30	15.3	0	0			80
33[b]	20.0	0	0			80
65	18.4	0	0			80
125	19.0	0	0			80
185	19.5	0	0			80
240	19.7	0	0			80
10-minute shutdown						
Cycle 2:						
0	8.8	0	0			79
2[b]	20.0					
5	22.3	0	0	1.29[a]	17-19	
15	21.8	0	0			80
60	21.5		0			80
120	21.5	1	0			80
180	21.5	2	0			81
240	22.0	2	0			80
10-minute shutdown						
Cycle 3:						
0	12.5	5[c]	0			80
2[b]	20.0	5	0			80
5	23.8	5	0	0.14	10-12	80
60	22.9	5	0			80
120	23.8	5	0			80
180	25.1	5	0			80
240	24.9	5	0			80
450-minute shutdown						
Cycle 4:						
0	---	0	0			
1[b]	20.0	7	0			75
5	25.0	4	0	0.05	4-5	76
10	---	0	0			80
55	24.6	0[d]	0			81
115	25.5	2	0			80
175	26.1	2	0			80
240	26.5	6	0			80
10-minute shutdown						

TABLE 62 . SINGLE-ELEMENT LOOP TEST NO. 108 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
Cycle 5:						
0	12.0	0	0			80
2(b)	20.0	5	0			80
5	27.9	2	0	0.05	8-9	
50	27.9	7	0			80
110	27.2	7	0			80
170	28.8	8	0			80
240	29.7	9	0			80
10-minute shutdown						
Cycle 6:						
0	17.6	10(e)	0			80
2(b)	40.0	10	0	0.24	8-9	80
7	48.1	10	0			80
11	37.5	0	0			80

(a) Pieces of Teflon tape on filter.
(b) Solids injection discontinued.
(c) Influent Totamitor reading 5 throughout cycle, but checks on influent fuel quality did not indicate contamination.
(d) Influent Totamitor reading 7 from 60 to 71 minutes, then variable readings from 1 to 10 during balance of cycle.
(e) Influent Totamitor readings varied from 0 to 10 during injection.

TABLE 62 . LOOP TEST NO. 108 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

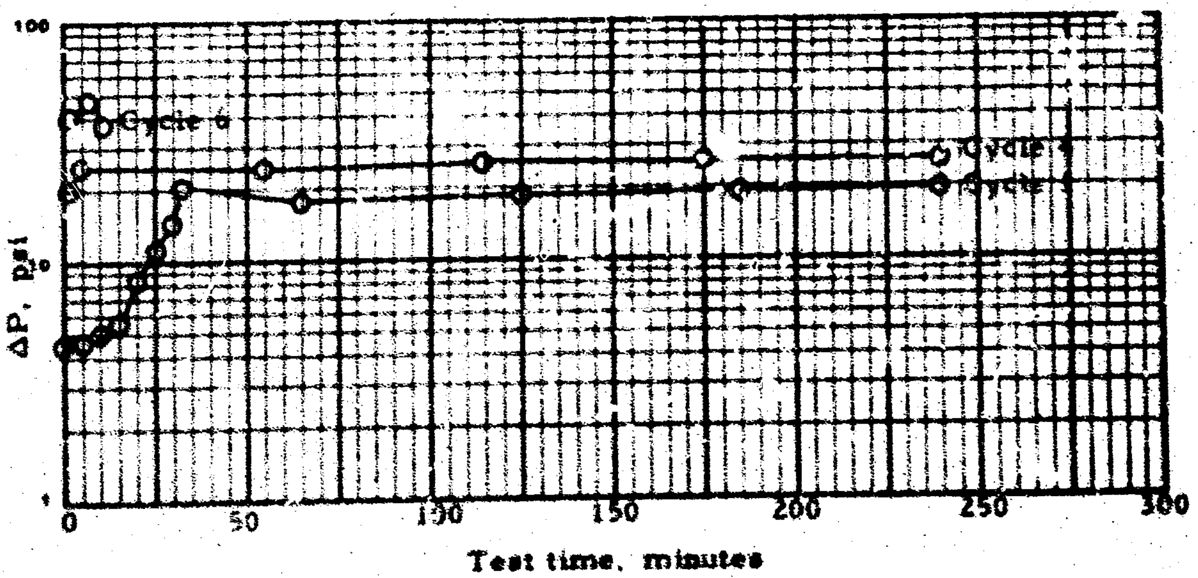


TABLE 63 . SINGLE-ELEMENT LOOP TEST NO. 109 Date: 28 Aug 67

Loop no. 3 (Al/SS)		Housing: 8" I. D. aluminum	
		Element: Filters Inc. I-4208 Lot 440	
		Canister: DoD type 1	
Procedure no. 13-A		Fuel flow, gpm	20
Water: Filtered tap water		Fuel inlet temperature, °F	80
Solids: Coarse AC dust		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi; then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi; then discontinued 15 min; then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 28 Aug 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, DuPont RP-2 , Lot 333

Test duration, min	50	Calculated dirt loading, g	200
Fuel throughput, gal	999	Actual element weight gain, g	184
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	317	1316
Screen ΔP, psi	3	3
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	34
IFT, distilled water, dyn/cm	26.8

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.5
ST, dyn/cm	72.0

TABLE 63 . SINGLE-ELEMENT LOOP TEST NO. 109 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.5	0	0			78
5	4.5	0	0	0.07	0	
10	4.6	0	0			
15	5.5	0	0			78
20	8.0	0	0			
25	11.0	0	0			
30	14.6	0	0			79
33	20.0	0	0[(a)]	0.15	2-3	79
38	26.6	0	0	0.03	6-7	79
43	27.0	0	0		9-10	79
48	28.5	0	0[(a)]			79
50	40.0	0	0	0.09	10-11	79

(a) Effluent Totamitor readings of 1 at 34 min and 45 min.

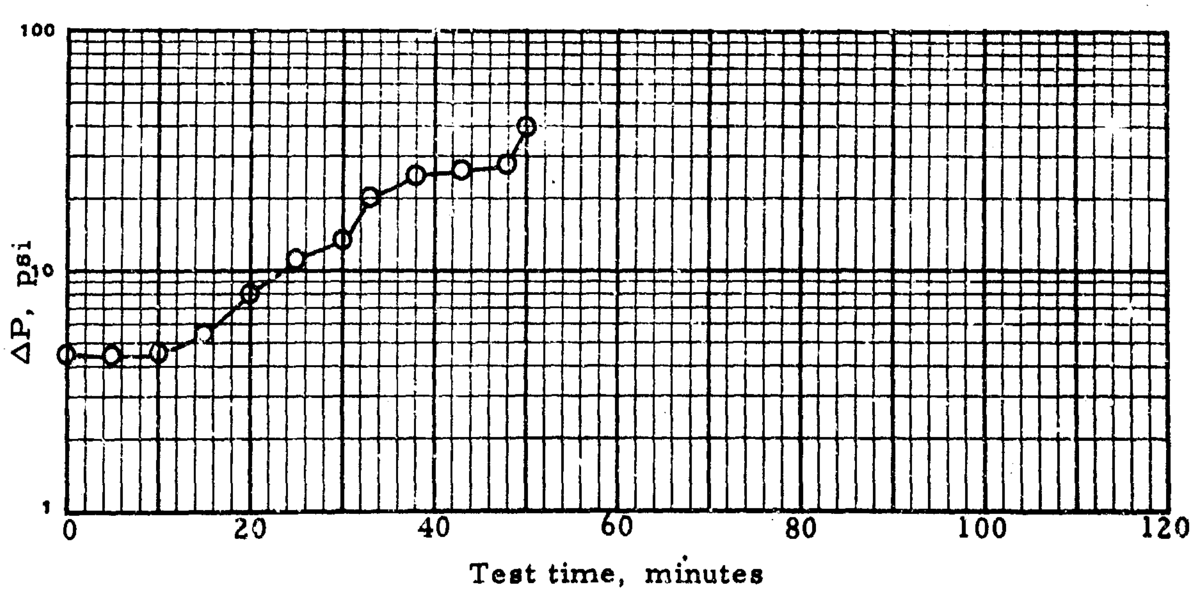


TABLE 64. LOOP TEST NO. 110

Date: Blended 28 August 1967
Tested 29 August 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 18 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 0306720 0.15 vol. %
Corrosion inhibitor, duPont RP-2 Lot 353 20 lb/Mbbl

Fuel inlet temperature, °F 79-80
Test duration, min 122
Fuel throughput, gal 2458
Avg. flow rate, gpm 20.1

Actual element weight gain, g 338
Calculated dirt loading, g 355

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.20	Neg.	0.02
	WSIM, dist. water	31		
	WSIM, inj. water	38		25
	IFT, dist. water, dyn/cm	26.5		
	IFT, inj. water, dyn/cm	22.1		23.3
	FSII content, vol. %	0.14		0.03
Injection water	Solids, mg/liter		0.2	
	pH		8.4	8.4
	ST, dyn/cm		66.7	67.1
Coalesced water	pH		7.3	7.5
	ST, dyn/cm		35.7	36.2
	FSII content, vol. %		4.00	1.50

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0	0			0
Cleanup ΔP, psi	0	0	0	0			0
Throughput, gal	320	919	1522	2226			2778

TABLE 64. LOOP TEST NO. 110 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	4.3			0
10	5.4			0
20	5.4			0
30	5.7	0.06	2-3	0
40	5.9			0
50	5.9			0
60	5.9			0
70	6.3			0
80	7.3			0
90	8.7			0
95	9.3	0.04	3-5	0
100	10.4			0
110	14.5			0
116	20.0	0.18	8-10	0
120	28.5			0
122	40.0	0.20	2-3	0

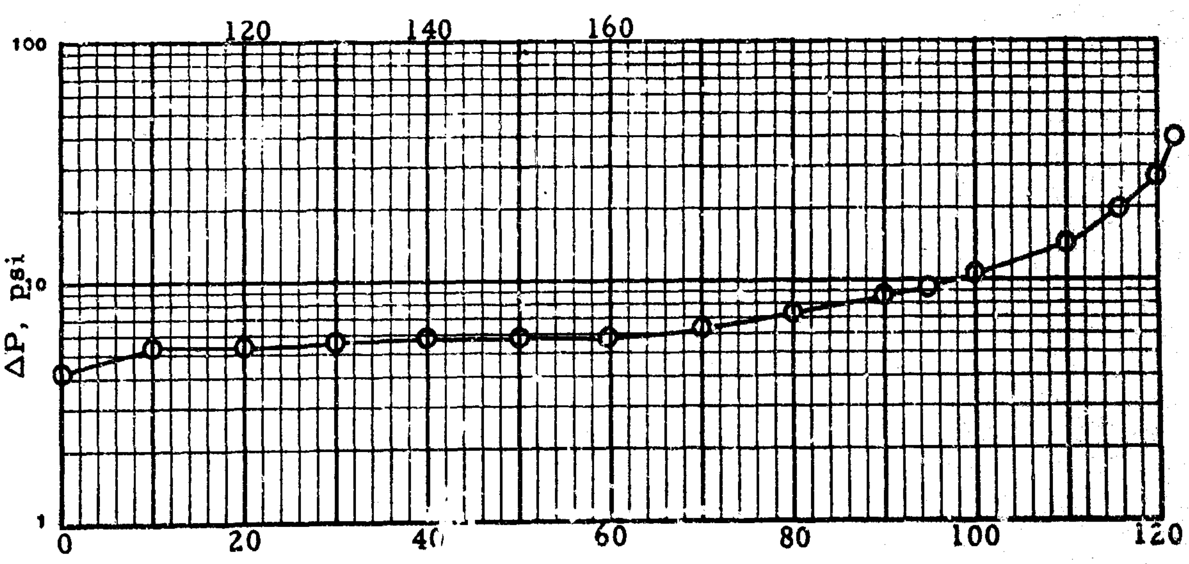


TABLE 65 . SINGLE-ELEMENT LOOP TEST NO. 111 Date: 30 Aug 67

Loop no. 3 (Al/SS)

Housing: 8" I.D. aluminum
Element: Filters Inc. I-4208 Lot 440
Canister: DoD type 1

Procedure no. 13-G
Water: Filtered tap water
Solids: Coarse AC dust

Fuel flow, gpm	20[a]
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 10 psi, then 0.2 gpm for 15 min, then increased stepwise to 1.2 gpm, then decreased to 0.0032 and 0.00032 gpm.
Solids injection schedule: 5.72 g/min from 0 min to 10 psi, then discontinued.

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 29 Aug 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, DuPont RP-2 , Lot 333

Test duration, min	317
Fuel throughput, gal	9244
Average rate, gpm	29.1

Calculated dirt loading, g	97
Actual element weight gain, g	93

Time	0 min	End test
Meter reading, gal	316	9560
Screen ΔP, psi	2	6
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	43
IFT, distilled water, dyn/cm	26.7

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.2
ST, dyn/cm	72.2

(a) Fuel flow rate 20 gpm during first part of test (loading to 10 psi, plus 15 min water injection at 0.2 gpm). Fuel flow rate then increased stepwise to 32 gpm.

TABLE 65. SINGLE-ELEMENT LOOP TEST NO. 111 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids[(a)] Bottle	Effluent, mg/liter Solids[(a)] Line	Effluent, mg/liter Free water	Infl. fuel temp., °F	Rates set to: Fuel, gpm	Rates set to: Water, gpm	Rates set to: Solids, g/min
0	5.2	0	0				80	20	0.002	5.72
5	5.2	0	2	0.87[(b)]		0-1	80			
10	6.0	0	2				80			
15	8.5	0	2				80			
17	10.0	0	2	0.92[(b)]		0-2	80	20	0.2	0
20	14.4	0	0				80			
22		0	0	0.21		4-5				
27	15.7	0	0			5-6	80			
32		0	0			3-5	80	22	0.22	0
37	18.0	0	0			6-8	80			
42	18.2	0	0			9-10	80			
47	19.5	0	0			10-12	80	24	0.24	0
52	20.0	0	0			10-11	80			
57	20.3	0	0			6-8	80			
62		0	1			12-13		26	0.26	0
65	22.7	0	1			7-8	80			
72	22.5	0	1			9-10	80			
77	24.0	0	1			9-10	80	28	0.28	0
82	24.2	0	1			10-11	80			
87	24.3	0	1			10-11	80			
92	25.8	0	2			14-16	80	30	0.30	0
95		0	2				80			
97	26.0	0	2			8-9	80			
102	26.5	0	3			6-8	80	32	0.32	0
107	27.0	0	3			9-10	80			
112	27.0	0	3			8-10	80			
117	27.2	0	3			8-10	80			
132	27.3	0	3			3-4	80			
137	27.3	0	3			3-4	80	32	0.34	0
142	27.6	0	3			8-10	80	32	0.36	0
147	27.6	0	3			9-11	80	32	0.38	0
152	27.8	0	3			8-10	80	32	0.40	0
157	27.9	0	3			3-5	80	32	0.45	0
162	28.0	0	3			10-12	80	32	0.50	0
167	28.3	0	4			10-12	79	32	0.60	0
172	28.6	0	4			12-13	79	32	0.70	0
177	28.9	0	5			12-14	79	32	0.80	0
182	29.2	0	5			14-15	79	32	1.00	0
187	29.9	0	51	0.21		18-20	79	32	1.20	0
192	30.7	0	20			20+	79	32	1.17	0
202	30.4	0	10			17-18	79			

(continued next page)

TABLE 65. SINGLE-ELEMENT LOOP TEST NO. 111 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids[(a)] Bottle	Effluent, mg/liter Solids[(a)] Line	Effluent, mg/liter Free water	Infl. fuel temp., °F	Rates set to: Fuel, gpm	Rates set to: Water, gpm	Rates set to: Solids, g/min
202	30.4	0	10			17-18	79			
207	30.4	0	8			17-18	78			
212	30.5	0	10			17-18	78	32	1.18	0
227	30.5	0	8		0.21	17-18	80			
237	30.5	0	7		Neg.	19-20	80			
247	30.7	0	7	0.19	0.03	10-12	80			
257	30.9	0	6		0.02	16-18	80			
267	30.8	0	6	0.10	0.17	20+	80			
277	31.5	0	5	0.14	Neg.	16-17	80			
287	28.6	0	0	0.00	0.04	18-19	80	32	0.032	0
292	27.6	0	0			1-2	80			
297	27.6	0	0			0-2	80			
302	27.6	0	0			0-1	80	32	0.0032	0
307	27.0	0	0			0-1	80			
312	27.0	0	0			0-1	80			
317	27.0	0	0	0.37		0-1	80			

(a) Bottled samples 1 gal; line samples 1 liter through matched pads.
(b) Brownish material on pads, apparently fiberglass.

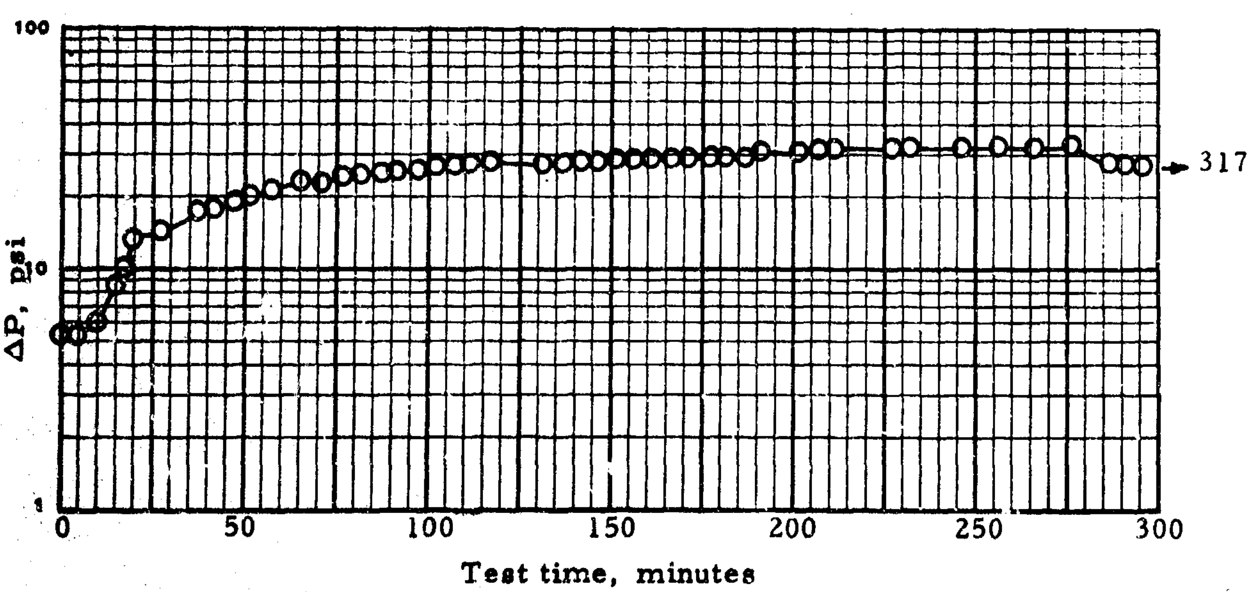


TABLE 66 . SINGLE-ELEMENT LOOP TEST NO. 112 Date: 31 Aug 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD type 1

Procedure no. 13-H	Fuel flow, gpm	20[a]
Water: Filtered tap water	Fuel inlet temperature, °F	80
Solids: Coarse AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi; then 0.2 gpm to end of test. Water injected into fuel pump suction.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi; then discontinued for 15 min; then 5.72 g/min up to 40 psi; then discontinued for remainder of test.

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 30 Aug 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, DuPont RP-2 , Lot 333

Test duration, min	42[b]	Calculated dirt loading, g	166
Fuel throughput, gal	820[b]	Actual element weight gain, g	152
Average rate, gpm	19.5[b]		

Time	0 min	40 psi
Meter reading, gal	320	1140
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	43
IFT, distilled water, dyn/cm	28.9

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.
pH	7.3
ST, dyn/cm	71.1

(a) Fuel flow rate 20 gpm during "regular" test (up to 40 psi), then decreased stepwise to 10 gpm.
(b) "Regular" test only (up to 40 psi).

TABLE 66 . SINGLE-ELEMENT LOOP TEST NO. 112 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.3	(a)	0			75
5	4.6	(a)	0	0.11	2-3	76
10	5.2	(a)	3			80
15	7.5	(a)	0			80
20	11.0	(a)	0			79
23		(a)	0		4-5	
25	16.0	(a)	0			80
27	20.0	(a)	0	Neg.	4-6	80
30	20.5	(a)	0			80
32	27.0	(a)	4	0.12	3-4	80
35	30.0	(a)	9			
40	38.0	(a)	27			
42	40.0	(a)	36	0.09	18-19	80
45	40.5	(a)	39			
Fuel flow set to 18 gpm						
50	42.0	(a)	57			
52				0.04(b)	20+	
55	42.5	(a)	70			
60	40.5	(a)	60			
Fuel flow set to 16 gpm						
65	38.9	(a)	60		20+	
70	39.0	(a)	63			
75	38.0	(a)	52			
Fuel flow set to 14 gpm						
80	34.5	(a)	45		19-20	
85	35.4	(a)	44			
90	36.2	(a)	29			
Fuel flow set to 12 gpm (c)						
95	31.5	(a)	34		18-19	
100	31.6	(a)	35			
105	32.5	(a)	37			
Fuel flow set to 10 gpm						
110	28.0	(a)	23		12-14	
115	21.0	(a)	14			
124	10.0	(a)	12	0.02	4-5	
Unable to set flow below 10 gpm						

(a) Influent Totamitor read 100 during first 27 minutes of run, then dropped to 45 when injection of 0.2 gpm water was started; subsequently disconnected.
(b) Sample cloudy.
(c) Effluent fuel stream cloudy.

TABLE 66. LOOP TEST NO. 112 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

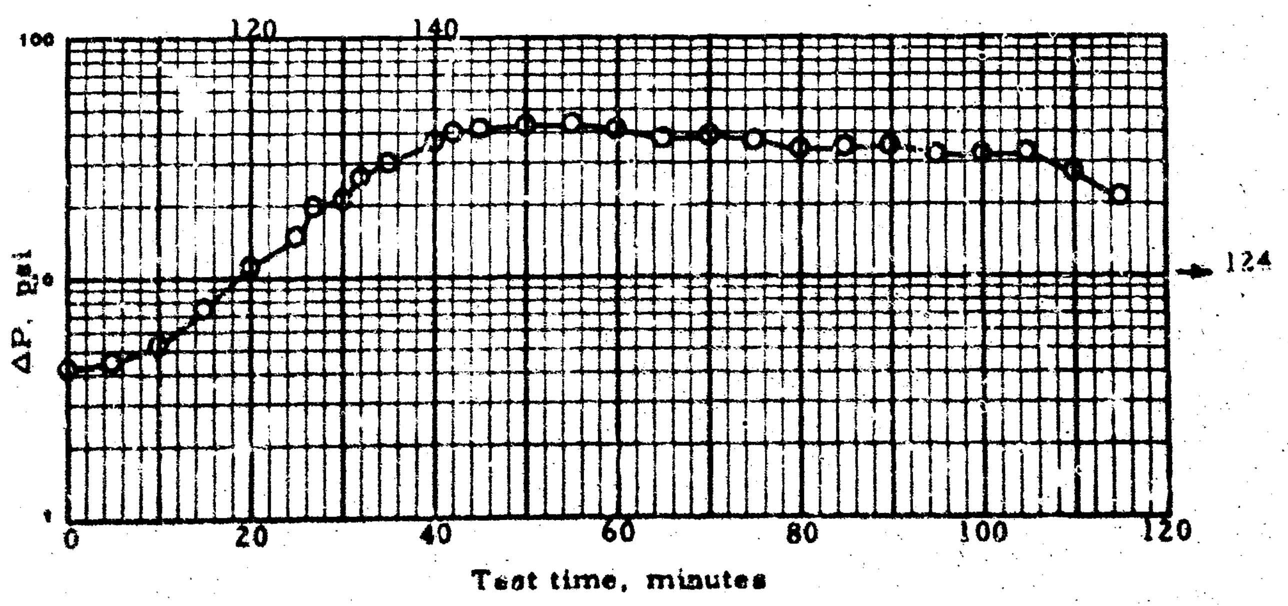


TABLE 67 . SINGLE-ELEMENT LOOP TEST NO. 113 Date: 5 Sep 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD type 1

Procedure no.	13-I	Fuel flow, gpm	16
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Coarse AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi; then 0.2 gpm to end of test. Water injected into fuel pump suction.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi; then discontinued for 15 min; then 5.72 g/min up to 40 psi.

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 5 Sep 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, DuPont RP-2 , Lot 333

Test duration, min	36(a)	Calculated dirt loading, g	183
Fuel throughput, gal	568	Actual element weight gain, g	(b)
Average rate, gpm	15.8		

Time	0 min	End test
Meter reading, gal	249	817
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	32
IFT, distilled water, dyn/cm	27.0

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.3
pH	7.3
ST, dyn/cm	70.7

(a) Test terminated early (before reaching 40 psi) because of excessive contaminants in effluent fuel.

(b) Element not weighed after test. Element sectioned immediately after draining to determine condition. A portion of the end was broken, and there was a heavy residue of AÇ dust present at the break. Test results INVALID.

TABLE 67 . SINGLE-ELEMENT LOOP TEST NO. 113 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.6	(a)	0			80
5	3.5	(a)	2	0.04	4-5	80
10	3.5	(a)	2			80
15	4.5	(a)	3			80
20	7.4	(a)	3			80
25	10.9	(a)	7			80
28	14.0	(a)	12		17-18	80
30	16.2	(a)	16			80
32	20.0	(a)	77	5.69[b]	20+	80
36	29.0	(a)	100	2.03[b]	20+	80[c]

(a) Influent Totamitor disconnected.
(b) AC dust visible on filter in solids determination.
(c) Pump discharge temperature 90°F throughout test.

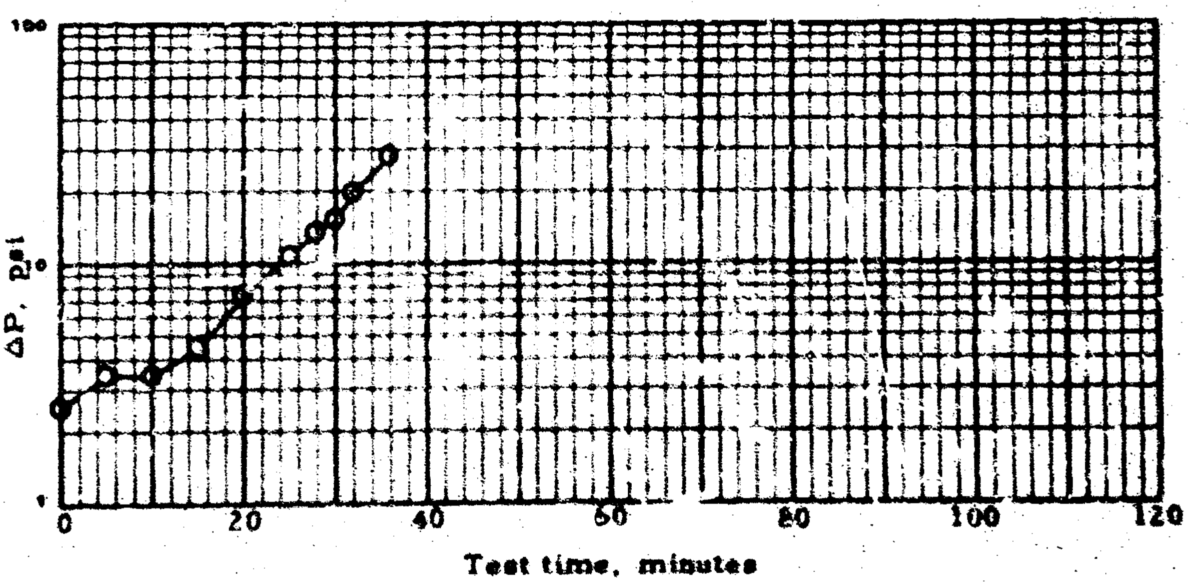


TABLE 68 . SINGLE-ELEMENT LOOP TEST NO. 114 Date: 6 Sep 67

Loop no.	3 (Al/SS)	Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1
Procedure no.	13-I	Fuel flow, gpm	16
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Coarse AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test. Water injected into fuel pump suction.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 5 Sep 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, duPont RP-2 , Lot 333

Test duration, min	54	Calculated dirt loading, g	223
Fuel throughput, gal	864	Actual element weight gain, g	204
Average rate, gpm	16.0		

Time	0 min	End test
Meter reading, gal	248	1112
Screen ΔP, psi	2	2
Cleanup ΔP, psi	0	2.5

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	68
IFT, distilled water, dyn/cm	26.8

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.4
ST, dyn/cm	72.0

TABLE 6? . SINGLE-ELEMENT LOOP TEST NO. 114 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F (b)
0	2.5	0	0			79
5	2.6	100	0	Neg.	2-3	80
10	2.9	(a)	0			80
15	3.5	(a)	0			79
20	4.8	(a)	0			80
25	7.4	(a)	0			80
30	12.0	(a)	0			80
35	20.0	66	1	0.36	5-6	80
40	25.5	62	15	0.10	8-9	80
45	27.0	62	15		3-4	80
50	28.0	62	17	0.08	3-4	80
54	40.0	62	12	0.06	7-8	80

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-35	0.002	5.72
	35-50	0.2	----
	50-54	0.2	5.72

(a) Influent Totamitor off until 20 psi was reached.

(b) Pump discharge temperature 82°F at start, 86°F at 10 min, and 88°F at 25 min and thereafter.

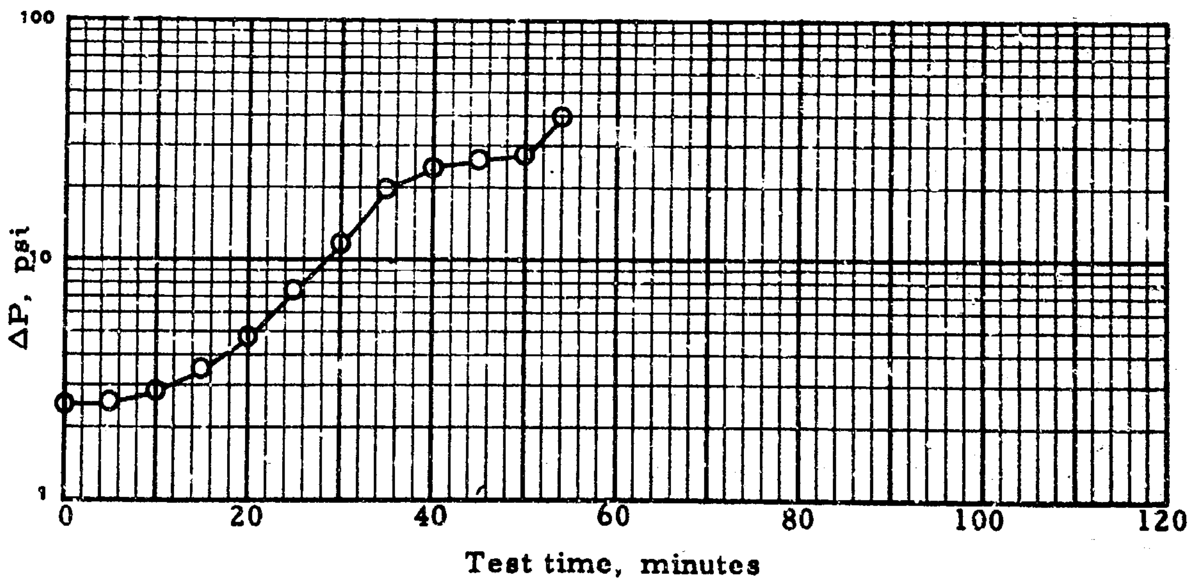


TABLE 69 . SINGLE-ELEMENT LOOP TEST NO. 115 Date: 7 Sep 67

Loop no. ? (Al/SS)

Housing: 8" I.D. aluminum
Element: Filters Inc. I-4208 Lot 440
Canister: DoD Type 1

Procedure no. 13-J
Water: Filtered tap water
Solids: Fine AC dust

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test. *

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 6 Sep 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, duPont RP-2 , Lot 333

Test duration, min 30
Fuel throughput, gal 588
Average rate, gpm 19.6

Calculated dirt loading, g 160
Actual element weight gain, g 131

Time	0 min	End test
Meter reading, gal	297	885
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0.5

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	32
IFT, distilled water, dyn/cm	27.1

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.5
ST, dyn/cm	71.5

* In this test, pressure drop reached 40 psi before the end of the 15-minute no-solids period; therefore, the second scheduled solids injection was not actually performed.

TABLE 69 . SINGLE-ELEMENT LOOP TEST NO. 115 (Cont'd)

Time, min	ΔP, psi	Rotameter Infl.	Rotameter Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.1	0	0			(b)
5	3.5	0	10	3.26(a)	2-3	80
10	4.0	0	14			80
15	4.6	0	15			80
20	6.4	0	17			80
25	11.5	0	19			80
28	20.0	0	21	16.12(a)	17-18	80
30	40.0	0	15	8.96(a)	20+	80

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-28	0.002	5.72
	28-30	0.2	----

(a) AC dust visible on test filter.
(b) Pump discharge temperature 83°F throughout test.

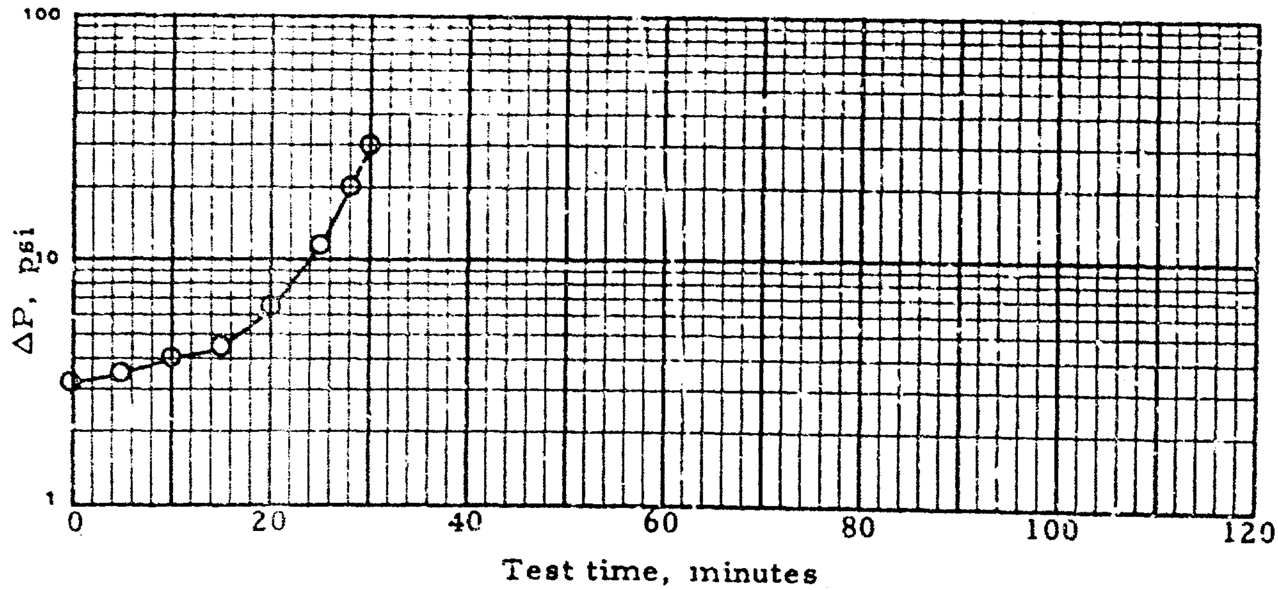


TABLE 70 . SINGLE-ELEMENT LOOP TEST NO. 116 Date: 7 Sep 67

Loop no. 3 (Al/SS)	Housing: 8" I.D. aluminum
	Element: Filters Inc. I-4208 Lot 440
	Canister: DoD Type 1

Procedure no.	13-K	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.2 gpm throughout test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test. *

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 7 Sep 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, du Pont RP-2 , Lot 333

Test duration, min	42	Calculated dirt loading, g	177
Fuel throughput, gal	823	Actual element weight gain, g	160
Average rate, gpm	19.6		

Time	0 min	End test
Meter reading, gal	305	1128
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	49
IFT, distilled water, dyn/cm	26.7

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.5
ST, dyn/cm	71.4

* In this test, pressure drop reached 40 psi before the end of the 15-minute no-solids period; therefore, the second scheduled solids injection was not actually performed.

TABLE 70 . SINGLE-ELEMENT LOOP TEST NO. 116 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F (a)
0	4.3	0	0			82
5	5.5	0	1	0.08	1-2	82
10	6.0	0	1			82
15	7.5	0	1			82
20	9.0	0	1			82
25	11.1	0	1			82
30	18.4	0	2			82
31	20.0	0	2	0.57	3-4	82
35	29.1	0	3			82
36	29.9	0	3	0.36	3-4	82
40	37.0	0	3			82
41	38.2	0	3		7-8	82
42	40.0	0	3	0.34	11-12	82

Schedule:

Minutes	Water, gpm	Solids, g/min
0-31	0.2	5.72
31-42	0.2	----

(a) Pump discharge temperature 92°F throughout test.

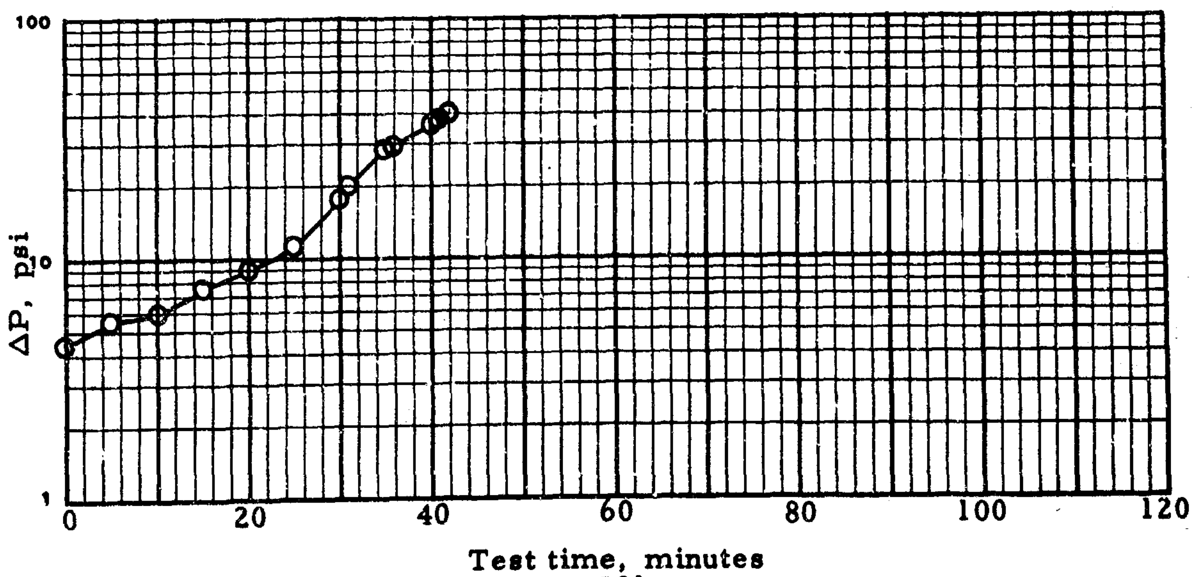


TABLE 71. SINGLE-ELEMENT LOOP TEST NO. 117 Date: 8 Sep 67

Loop no. 3 (Al/SS)		Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no.	13-L	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.2 gpm throughout test.

Solids injection schedule: 5.72 g/min from 0 min to 10 psi, then discontinued up to total test time of 120 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 7 Sep 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, duPont RP-2 , Lot 333

Test duration, min	130	Calculated dirt loading, g	286
Fuel throughput, gal	2583	Actual element weight gain, g	281
Average rate, gpm	19.9		

Time	0 min	End test
Meter reading, gal	328	2911
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	50
IFT, distilled water, dyn/cm	26.5

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.4
ST, dyn/cm	71.8

TABLE 71. SINGLE-ELEMENT LOOP TEST NO. 117 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F (c)
0	3.6	0	0			80
5	4.7	0	5	1.28	9-10	80
10	5.2	0	5	(a)		80
15	5.5	0	5			80
20	6.0	0	5			80
25	6.7	0	6			80
30	7.5	0	7			80
35	8.5	0	8			80
40	10.0	0	4	2.53	9-10	80
45	11.0	0	3	1.11	9-10	80
50	11.4	0	3		9-10	80
55	11.9	0	3		9-10	80
60	12.4	0	3			80
65	13.3	0	3			80
70	13.6	0	3			80
75	14.1	0	3			80
80	14.5	0	3			80
85	15.0	0	3			80
90	15.4	0	3			80
95	15.6	0	3			80
100	16.0	0	3			80
105	16.4	0	3			80
110	16.6	0	3			80
115	17.0	0	3			80
120	17.5	0	3		3-4	80
125	25.3	0	5			80
130	40.0	0	9	2.02(b)	14-15	80

Schedule:

Minutes	Water, gpm	Solids, g/min
0-40	0.2	5.72
40-120	0.2	----
120-130	0.2	5.72

(a) AC dust visible on all test filters.
(b) Calculation based on weight of test pad only.
(c) Pump discharge temperature 88°F at start, 90°F at 0 min.

TABLE 71. LOOP TEST NO. 117 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

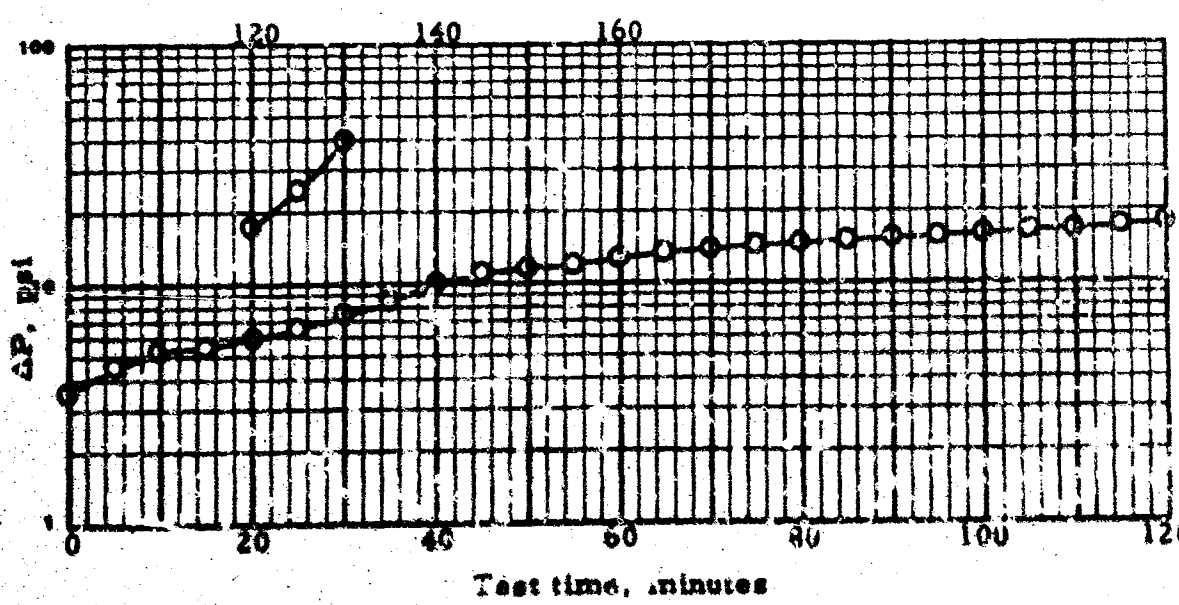


TABLE 72. SINGLE-ELEMENT LOOP TEST NO. 118 Date: 12 Sep 67

Loop no.	3 (Al/SS)	Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no.	14-A	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm throughout test. *

Solids injection schedule: 5.72 g/min from 0 min to 20 psi at start of each cycle. *

Test fuel JP-5 batch no. 18, fresh
Date blended with additives: 12 Sep 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, duPont RP-2, Lot 333

Test duration, min	160	Calculated dirt loading, g	160
Fuel throughput, gal	3162	Actual element weight gain, g	143
Average rate, gpm	19.8		

Time	0 min	End test
Meter reading, gal	344	3506
Screen ΔP, psi	2	1
Cleanup ΔP, psi	0	2

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	48
IFT, distilled water, dyn/cm	26.3

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.6
ST, dyn/cm	72.4

* Test schedule provides for five 4-hr cycles with a minimum of 10 min shutdown between cycles; however, test is terminated at any time when ΔP reaches 40 psi. If ΔP has not reached 40 psi by the end of the fifth cycle, water is injected at 0.2 gpm and solids at 5.72 g/min until 40 psi is reached. In Test 118, 40 psi was reached during first cycle.

TABLE 72 . SINGLE-ELEMENT LOOP TEST NO. 118 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.5	0	0			82
5	3.5	0	9	2.91(a)	0-1	80
10	4.0	0	12			80
15	5.1	0	14	4.30(a)		
20	7.9	0	14			
25	14.2	0	15			80
28	20.0	0	16		12-14	80
33		0	4			
39	28.0	0	3			80
54		0	3			80
69	33.2	0	4			80
84		0	5			80
99	34.9	0	5			80
114		0	6			80
129	36.5	0	7			80
144		0	8			80
160	40.0	0	9	Neg.	17-18	80

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-28	0.002	5.72
	28-160	0.002	----

(a) AC dust visible on test filter.

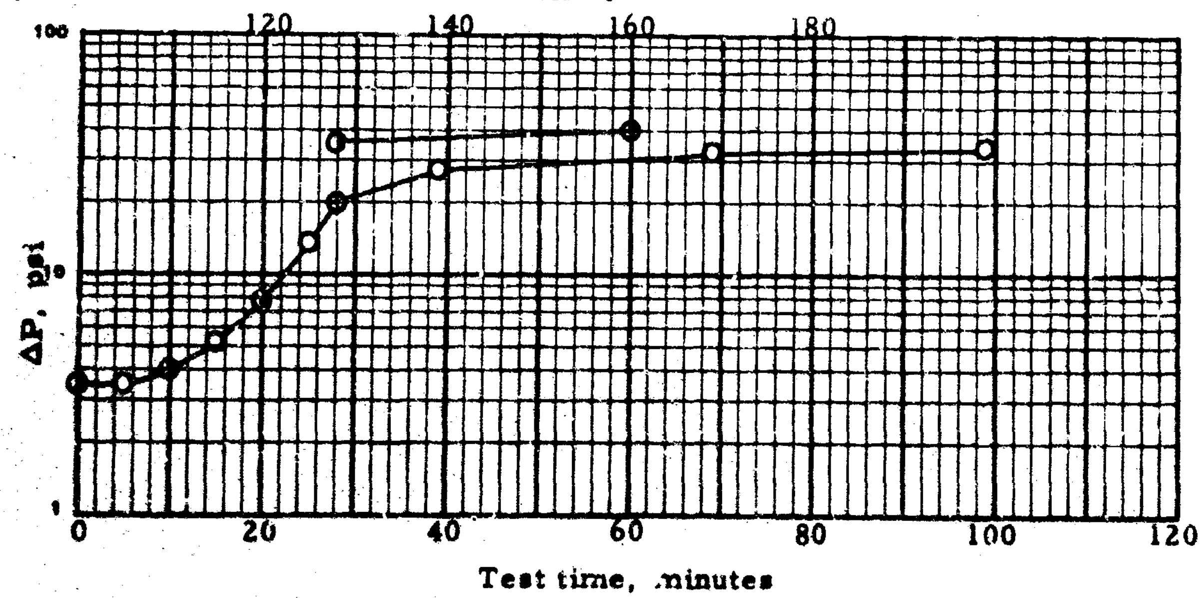


TABLE 73. SINGLE-ELEMENT LOOP TEST NO. 119 Date: 13 Sep 67

Loop no. 3 (Al/SS)

Housing: 8" I.D. aluminum
Element: Filters Inc. I-4208 Lot 440
Canister: DoD Type 1

Procedure no. 14-A
Water: Filtered tap water
Solids: Fine AC dust

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm throughout test. *

Solids injection schedule: 5.72 g/min from 0 min to 20 psi at start of each cycle. *

Test fuel JP-5 batch no. 18, fresh
Date blended with additives: 13 Sep 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, duPont RP-2, Lot 333

Test duration, min 138
Fuel throughput, gal 2750
Average rate, gpm 19.9

Calculated dirt loading, g 154
Actual element weight gain, g 156

Time	0 min	End test
Meter reading, gal	312	3062
Screen ΔP, psi	0	0
Cleanup ΔP, psi	1	2

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	47
IFT, distilled water, dyn/cm	27.9

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.5
ST, dyn/cm	71.9

* Test schedule provides for five 4-hr cycles with a minimum of 10 min shutdown between cycles; however, test is terminated at any time when ΔP reaches 40 psi. If ΔP has not reached 40 psi by the end of the fifth cycle, water is injected at 0.2 gpm and solids at 5.72 g/min until 40 psi is reached. In Test 119, 40 psi was reached during first cycle.

TABLE. 73 . SINGLE-ELEMENT LOOP TEST NO. 119 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.6					80
5	3.7	0	4	1.42(a)	0-1	80
10	4.3	0	7			80
15	5.0	0	8			80
20	7.1	0	11			80
25	13.4	0	14			80
27	20.0	0	13	11.63(a)	3-4	80
30	25.4	0	5			80
45	29.5	0	0			80
60	31.5	0	0			80
75	34.0	0	1			80
90	35.3	0	1			80
105	36.5	0	1			80
120	38.1	0	1			80
135	39.4	0	1			80
138	40.0	0	1	0.01	18-19	80

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-27	0.002	5.72
	27-138	0.002	----

(a) AC dust visible on test filter.

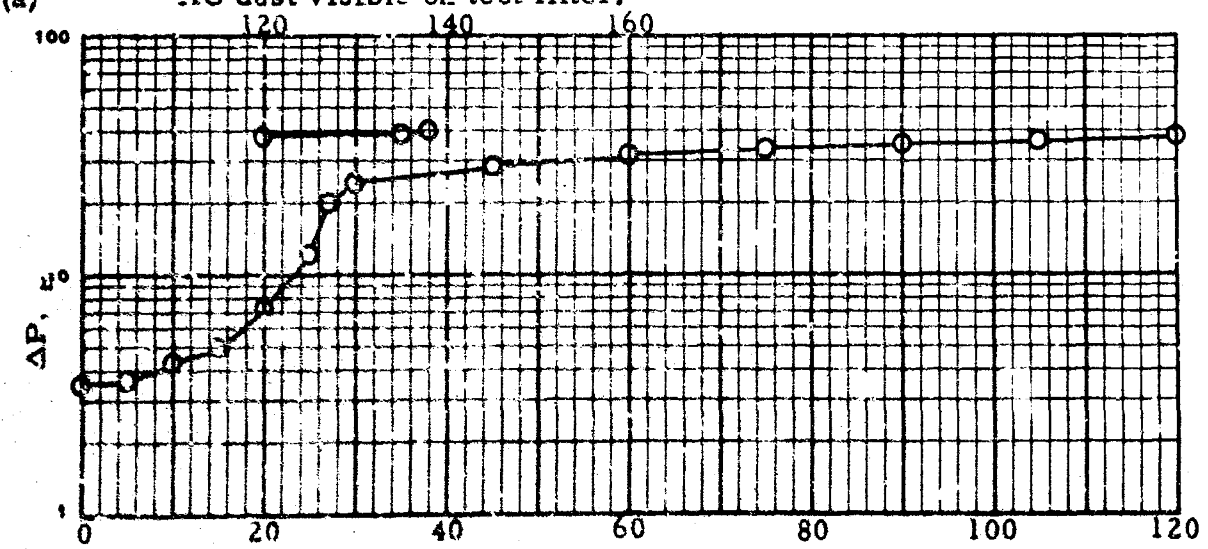


TABLE 74. SINGLE-ELEMENT LOOP TEST NO. 120 Date: 13 Sep 67

Loop no.	3 (Al/SS)	Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 44G
		Canister:	DoD Type 1
Procedure no.	14-B	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm throughout test. *

Solids injection schedule: 5.72 g/min from 0 min to 10 psi at start of each cycle. *

Test fuel JP-5 batch no. 18, fresh
Date blended with additives: 13 Sep 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, duPont RP-2, Lot 333

Test duration, min	216	Calculated dirt loading, g	223
Fuel throughput, gal	4288	Actual element weight gain, g	218
Average rate, gpm	19.8		

Time	0 min	End test
Meter reading, gal	321	4609
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	39
IFT, distilled water, dyn/cm	28.3

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.9
ST, dyn/cm	72.1

* Test schedule provides for five 4-hr cycles with a minimum of 10 min shutdown between cycles; however, test is terminated at any time when ΔP reaches 40 psi. If ΔP has not reached 40 psi by the end of the fifth cycle, water is injected at 0.2 gpm and solids at 5.72 g/min until 40 psi is reached. In Test 120, 40 psi was reached during first cycle.

TABLE 74 . SINGLE-ELEMENT LOOP TEST NO. 120 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.1	0	0			81
5	3.5	1	0	0.09	0-1	81
10	3.9	1	0			81
15	4.3	1	0			81
20	4.7	1	0			81
25	5.4	1	0			81
30	6.5	1	0			81
35	8.1	2	0			81
39	10.0	2	0			81
40	10.9	2	0			81
45	12.3	1	0	0.08(a)	0-1	80
50	13.4	1	0			80
55	14.9	1	1			80
60	15.6	1	1			80
75	17.9	1	2			80
90	20.3	1	3			80
105	22.2	1	4			80
120	24.5	1	4			80
135	26.7	1	5			80
150	28.8	1	5			80
165	31.5	1	5			80
180	34.0	1	7			80
195	35.5	1	8	0.06(a)	20	80
210	37.6	0	7			80
216	40.0	0	9	0.08	20+	80

Schedule:

Minutes	Water, gpm	Solids, g/min
0-39	0.002	5.72
39-216	0.002	----

(a) Millipore matched pad sample.

TABLE 74. LOOP TEST NO. 120 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

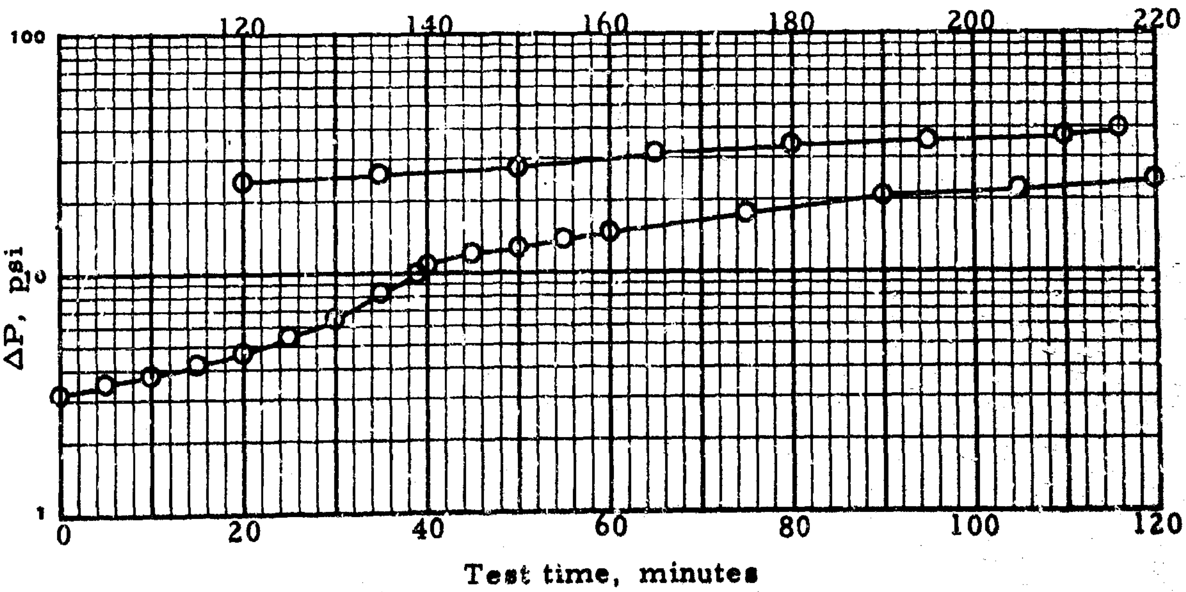


TABLE 75. SINGLE-ELEMENT LOOP TEST NO. 121 Date: 14 Sep 67

Loop no. 3 (Al/SS)		Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no.	14-A	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm throughout test. *

Solids injection schedule: 5.72 g/min from 0 min to 20 psi at start of each cycle. *

Test fuel JP-5 batch no. 18, fresh
Date blended with additives: 14 Sep 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, duPont AFA-1, Lot 37

Test duration, min	371	Calculated dirt loading, g	166
Fuel throughput, gal	7498	Actual element weight gain, g	91
Average rate, gpm	20.2		

Time	0 min	End test
Meter reading, gal	302	7759
Screen ΔP, psi	0	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	79
IFT, distilled water, dyn/cm	21.4

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.7
ST, dyn/cm	72.3

* Test schedule provides for five 4-hr cycles with a minimum of 10 min shutdown between cycles; however, test is terminated at any time when ΔP reaches 40 psi. If ΔP has not reached 40 psi by the end of the fifth cycle, water is injected at 0.2 gpm and solids at 5.72 g/min until 40 psi is reached. In Test 121, 40 psi was reached during second cycle.

TABLE 75 . SINGLE-ELEMENT LOOP TEST NO. 121 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
Cycle 1:						
0	4.0	0	0			79
5	4.5	0	10	3.27(a)	0-1	81
10	4.7	0	8	5.40(a, b)	0-1	80
15	6.1	0	7			80
20	8.3	0	6			80
25	12.4	0	6			80
29	20.0	0	4	0.58(a, b)	1-2	80
30	22.5	0	3			80
40	24.1	0	0			80
70	27.0	0	0			80
100	28.0	0	0			80
130	31.0	0	0			80
162	32.3	0	0			80
175	32.5	1	0			80
190	32.6	2	0			80
205	33.5	2	0			80
220	34.2	3	0			80
235	34.8	3	0			80
240	35.0	3	0	0.00	7-8	80
Cycle 2:						
0	34.8					70
5	30.8	3	2	0.26	10-11	76
10	31.5	2	2			79
25	32.0	1	1			80
55	35.6	1	2			80
85	37.6	1	2			80
115	39.1	1	2			80
131	40.0	1	2	0.19	14-16	80

Schedule:	Minutes	Water, gpm	Solids, g/min
Cycle 1	0-29	0.002	5.72
	29-240	0.002	----
Cycle 2	0-131	0.002	----

(a) AC dust visible on test filter.
(b) Millipore matched-weight filters.

TABLE 75. LOOP TEST NO. 121 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

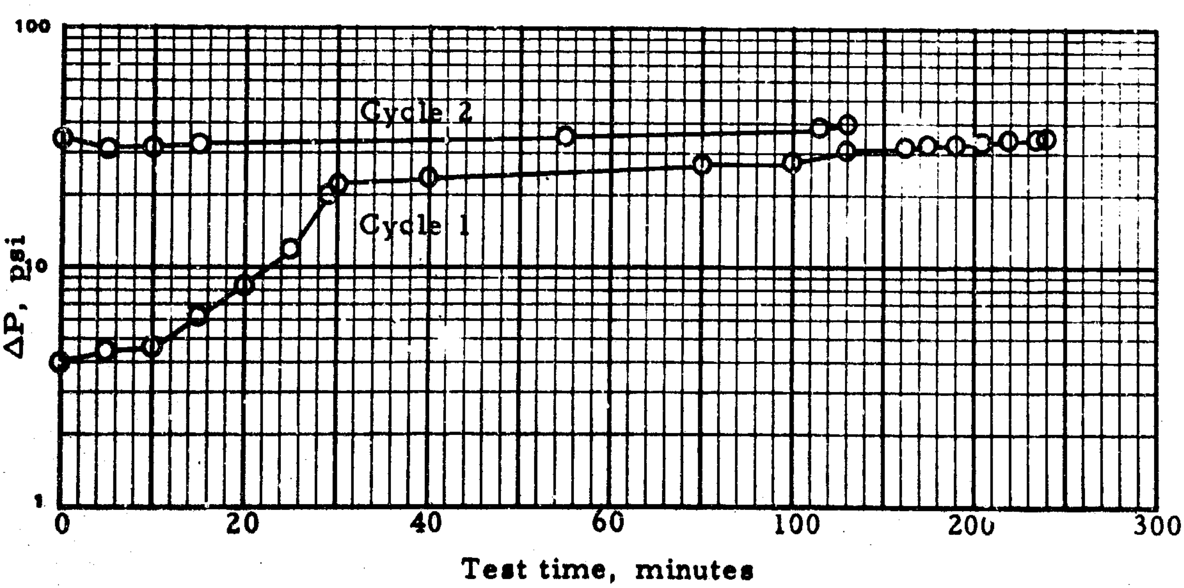


TABLE 76 . SINGLE-ELEMENT LOOP TEST NO. 122 Date: 15-18 Sep 67

Loop no. 3 (Al/SS)		Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1
Procedure no.	14-A	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm throughout test. *

Solids injection schedule: 5.72 g/min from 0 min to 20 psi at start of each cycle. *

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 15 Sep 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, duPont AFA-1 , Lot 37

Test duration, min	824	Calculated dirt loading, g	172
Fuel throughput, gal	16,513	Actual element weight gain, g	182
Average rate, gpm	20.0		

Time	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
Meter reading, gal	328	5140	0	4874	0	4801	0	2026
Screen ΔP, psi	0	0	0	0	0	2	2	2
Cleanup ΔP, psi	0	1	1	1	1	3	3	3

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	66
IFT, distilled water, dyn/cm	2[illegible]

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.3
ST, dyn/cm	72.1

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* Test schedule provides for five 4-hr cycles with a minimum of 10 min shutdown between cycles; however, test is terminated at any time when ΔP reaches 40 psi. If ΔP has not reached 40 psi by the end of the fifth cycle, water is injected at 0.2 gpm and solids at 5.72 g/min until 40 psi is reached. In Test 122, 40 psi was reached during fourth cycle.

TABLE 76 . SINGLE-ELEMENT LOOP TEST NO. 122 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
Cycle 1:						
0	3.5	0	0(a)			80
5	4.0	1	4	1.31	1-2	80
10	4.4	1	8			80
15	5.5	1	8			80
20	7.4	1	8			80
25	11.2	1	7			81
30	20.0	1	2		6-7	81
35	26.0	1	1			81
45	25.0	1	1			81
60	26.0	1	1			81
90	27.4	1	0			81
120	28.7	1	0			80
150	29.5	1	0			80
180	29.9	1	1			80
210	30.5	2	1			80
240	31.5	3	1	0.08	11-12	80
242	30.5	3	1			80
	3-min shutdown					
Cycle 2:						
0	27.3	3	1			80
5	27.0	3	1	0.00	10-11	80
20	28.6	3	1			80
30	29.5	3	1			80
45	30.1	4	1			80
60	30.6	4	1			80
90	32.1	3	1			80
120	32.6	2	1			80
155	34.1	3	1			80
185	34.8	4	1			80
215	35.5	4	1			80
240	36.5	5	2	0.25	19-20	80
242	35.0	5	2			80
	58-hr shutdown					

(a) Totamitor started to climb gradually as soon as test was started.

(continued next page)

TABLE 76 . SINGLE-ELEMENT LOOP TEST NO. 122 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
Cycle 3:						
0	35.6	2	1			76
5	29.9	1	1	Neg.	20+	80
10	30.6	1	1			80
25	33.0	1	1		10-12	80
40	34.2	1	1			80
55	35.0	1	1		10-12	80
85	36.3	1	1			80
115	36.4	2	0			80
130	36.8	4	1			80
135	35.9	3	1	0.02		80
145	37.2	7	1			80
160	37.8	7	2			80
175	37.9	6	2			80
205	38.5	6	2	0.06	1-2	80
220	39.0	7	5			80
235	39.0	7	6			80
240	39.0	7	6	(a)	(a)	80
	5-min shutdown					
Cycle 4:						
0	32.9	7	3			80
5	32.4	5	3	0.08	20+	80
20	34.0	4	3			80
35	35.0	7	4		17-18	80
50	36.0	7	3			80
65	36.9	7	4			80
80	38.0	12	5			80
95	39.2	12	5		(b)	80
100	40.0	12	5	Neg.	20+	80

Schedule:	Minutes	Water, gpm	Solids, g/min
Cycle 1	0-30	0.002	5.72
	30-242	0.002	----
Cycle 2	0-242	0.002	----
Cycle 3	0-240	0.002	----
Cycle 4	0-100	0.002	----

(a) No sample taken.
(b) Influent sample - 4-5 mg/liter free water.

TABLE 76 . LOOP TEST NO. 122 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

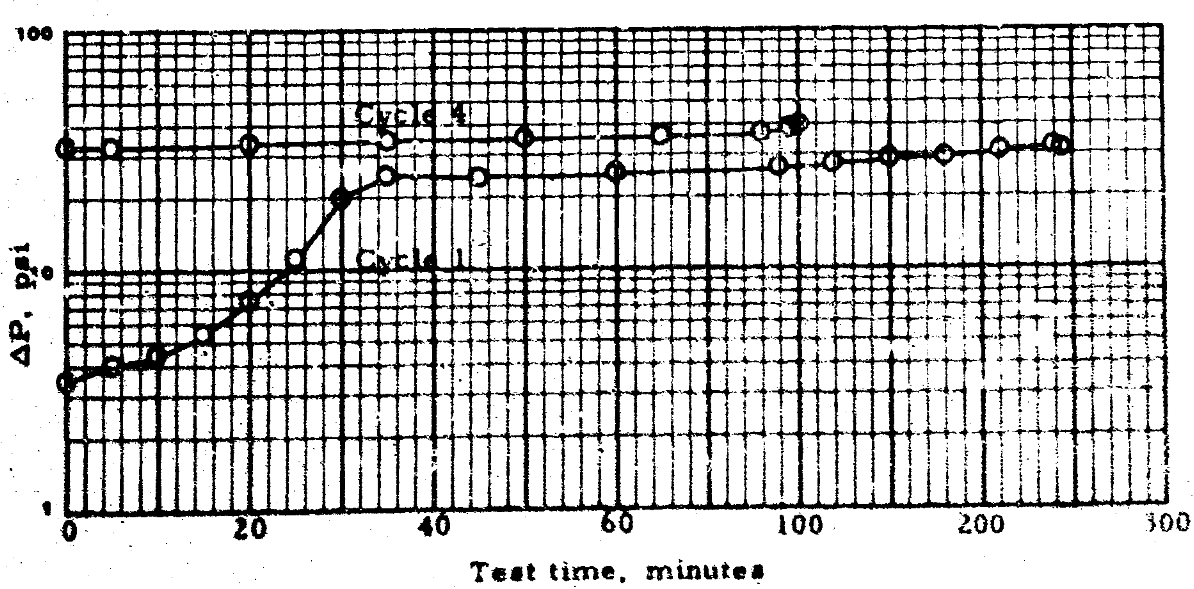


TABLE 77 . SINGLE-ELEMENT LOOP TEST NO. 123 Date: 19 Sep 67

Loop no. 3 (Al/SS)

Housing: 8" I.D. aluminum
Element: Filters Inc. I-4208 Lot 440
Canister: DoD Type 1

Procedure no. 14-A
Water: Filtered tap water
Solids: Fine AC dust

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm throughout test. *

Solids injection schedule: 5.72 g/min from 0 min to 20 psi at start of each cycle. *

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 16 Sep 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, duPont AFA-1 , Lot 37

Test duration, min 161
Fuel throughput, gal 3220
Average rate, gpm 20.0

Calculated dirt loading, g 246
Actual element weight gain, g 245

Time	0 min	End test
Meter reading, gal	303	3523
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	86
IFT, distilled water, dyn/cm	26.8

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.4
ST, dyn/cm	71.7

* Test schedule provides for five 4-hr cycles with a minimum of 10 min shutdown between cycles; however, test is terminated at any time when ΔP reaches 40 psi. If ΔP has not reached 40 psi by the end of the fifth cycle, water is injected at 0.2 gpm and solids at 5.72 g/min until 40 psi is reached. In Test 123, 40 psi was reached during first cycle.

TABLE 77 . SINGLE-ELEMENT LOOP TEST NO. 123 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.1	0	0			80
5	3.3	0	0	0.69	3-5	80
10	3.6	0	2			80
15	4.0	0	3			80
20	4.6	1	4			80
25	5.1	1	5			80
30	6.6	1	6			80
35	9.0	0	7			80
40	14.9	0	9			80
43	20.0	0	10	(a)	(a)	80
45	24.4	0	8			80
60	31.0	0	1			80
75	33.4	0	1			80
90	35.0	0	1			80
105	35.9	0	1			80
120	37.1	0	1			80
135	38.1	0	2			80
150	39.0	0	2			80
161	40.0	0	2	0.03	20+	80

(a) No sample taken.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-43	0.002	5.72
43-161	0.002	----

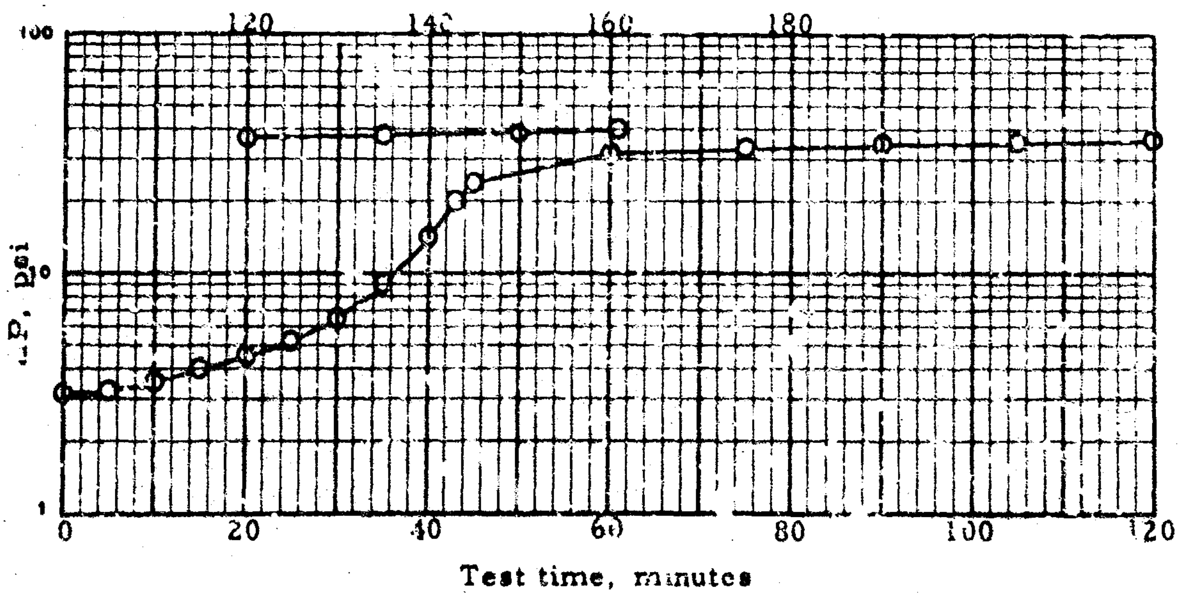


TABLE 78 . SINGLE-ELEMENT LOOP TEST NO. 124 Date: 21 Sep 67

Loop no.	3 (Al/3S)	Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no.	13-M	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	R-9998 red iron oxide	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test. *

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 19 Sep 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, du Pont AFA-1 , Lot 37

Test duration, min	47	Calculated dirt loading, g	263
Fuel throughput, gal	964	Actual element weight gain, g	182
Average rate, gpm	20.4		

Time	0 min	End test
Meter reading, gal	312	1276
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	No reading taken

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	50
IFT, distilled water, dyn/cm	21.8

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.5
pH	7.4
ST, dyn/cm	71.1

* In this test, pressure drop reached 40 psi before the end of the no-solids period; therefore, the second scheduled solids injection was not actually performed.

TABLE 78 . SINGLE-ELEMENT LOOP TEST NO. 124 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.5	0	0(a)			80
5	3.5	1	32	7.23	2-3	80
10	4.0	2	39			80
15	4.2	2	44	19.92	(b)	80
20	5.0	2	45			80
25	5.5	2	45			80
30	6.5	2	43			80
35	8.0	2	44			80
40	10.5	2	40			80
45	17.5	2	38			80
46	20.0	2	36	(c)	(b)	80
47	40.0	2	36	(c)	(b)	80

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-46	0.002	5.72
	46-47	0.02	----

(a) Effluent totamitor began recording high reading immediately upon injection.
(b) AEL pad covered with RIO, making reading impossible.
(c) Solids analyses not determined on account of high RIO content; sample red.

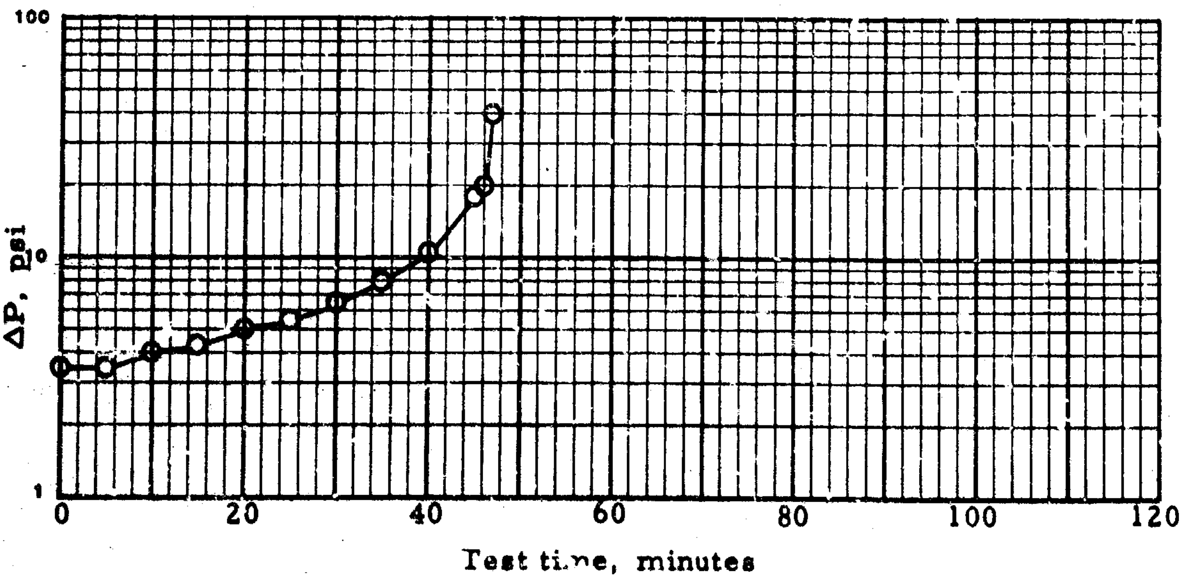


TABLE 79 . SINGLE-ELEMENT LOOP TEST NO. 125 Date: 25 Sep 67

Loop no. 3 (Al/SS)		Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1
Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Coarse AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 25 Sep 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, Santolene C , Lot M:04-006

Test duration, min	52	Calculated dirt loading, g	212
Fuel throughput, gal	1041	Actual element weight gain, g	209
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	309	1350
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

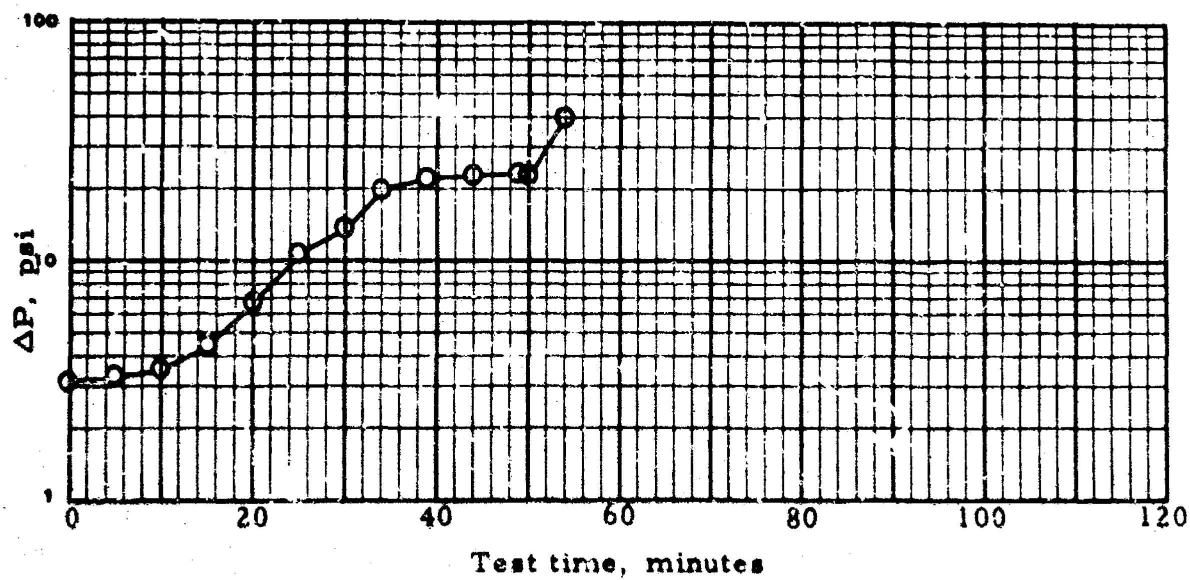
Time	Pre-test
WSIM, distilled water	78
IFT, distilled water, dyn/cm	33.6

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.3
ST, dyn/cm	71.4

TABLE 79 . SINGLE-ELEMENT LOOP TEST NO. 125 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.1	0	0			80
5	3.4	0	0	0.35	2-3	80
10	3.6	0	0			80
15	4.5	0	0			80
20	6.9	0	0			80
25	10.6	0	0			80
30	14.9	0	0			80
34	20.0	0	0	0.16	17-18	80
39	22.0	0	0	0.10	3-4	80
44	22.1	0	0		3-4	80
49	22.7	0	0		3-4	80
50	22.0	0	0			80
52	40.0	0	1	0.04	18-19	80



Schedule:

Minutes	Water, gpm	Solids, g/min
0-34	0.002	5.72
34-49	0.2	----
49-52	0.2	5.72

TABLE 80. SINGLE-ELEMENT LOOP TEST NO. 126 Date: 26 Sep 67

Loop no.	3 (Al/SS)	Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test. *

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 25 Sep 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, Santolene C , Lot NH04-006

Test duration, min	49	Calculated dirt loading, g	252
Fuel throughput, gal	983	Actual element weight gain, g	256
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	308	[illegible]91
Screen ΔP, psi	0	
Cleanup ΔP, psi	0	

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	53
IFT, distilled water, dyn/cm	33.8

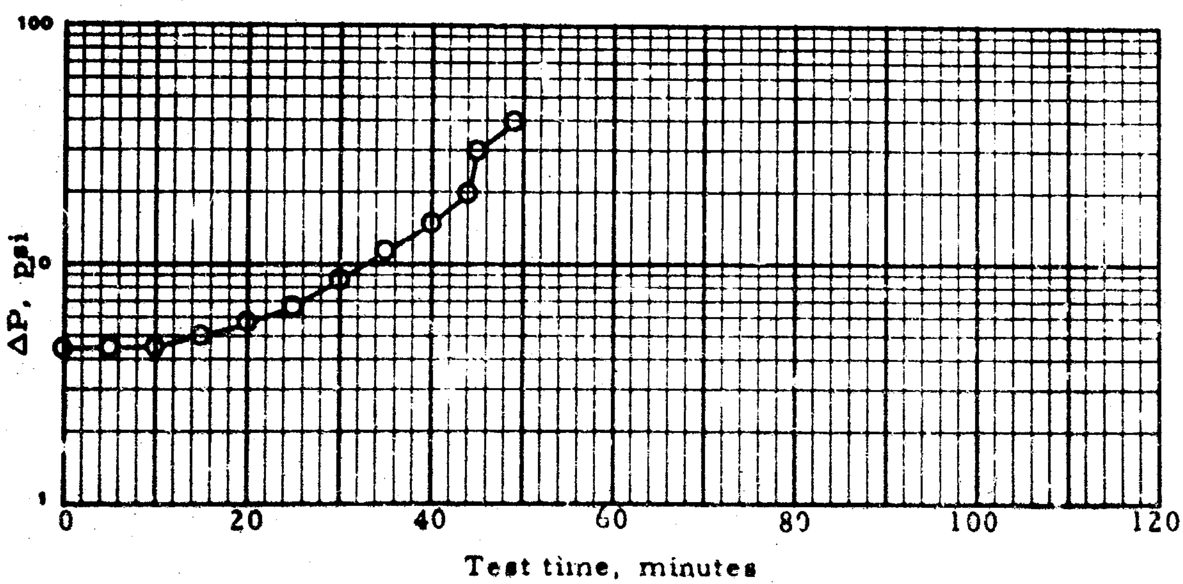
Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.3
pH	7.4
ST, dyn/cm	72.2

* In this test, the pressure drop reached 4[illegible] psi before the end of the no-solids period; therefore, the second scheduled solids injection was not actually performed.

TABLE 80 . SINGLE-ELEMENT LOOP TEST NO. 126 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.4	0	0			78
5	4.5	0	0	0.09	0	78
10	4.5	0	0			78
15	5.0	0	1			78
20	5.9	0	1			79
25	6.8	0	1			79
30	8.9	0	1			79
35	11.4	0	1			79
40	15.4	0	0			79
44	20.0	0	0	0.21	19-20	79
45	30.0	0	100	0.47	20+	79
49	40.0	0	100	0.53	20+	70



Schedule:

Minutes	Water, gpm	Solids, g/min
0-44	0.002	5.72
44-49	0.2	----

TABLE 81. SINGLE-ELEMENT LOOP TEST NO. 127 Date: 26 Sep 67

Loop no. 3 (Al/SS)		Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test. *

Test fuel JP-5 batch no. 18, fresh
Date blended with additives: 26 Sep 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, Santolene C, Lot NH04-006

Test duration, min	36	Calculated dirt loading, g	194
Fuel throughput, gal	700	Actual element weight gain, g	190
Average rate, gpm	19.7		

Time	0 min	End test
Meter reading, gal	307	1007
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0.5

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	59
IFT, distilled water, dyn/cm	34.6

Analyses on injection water:

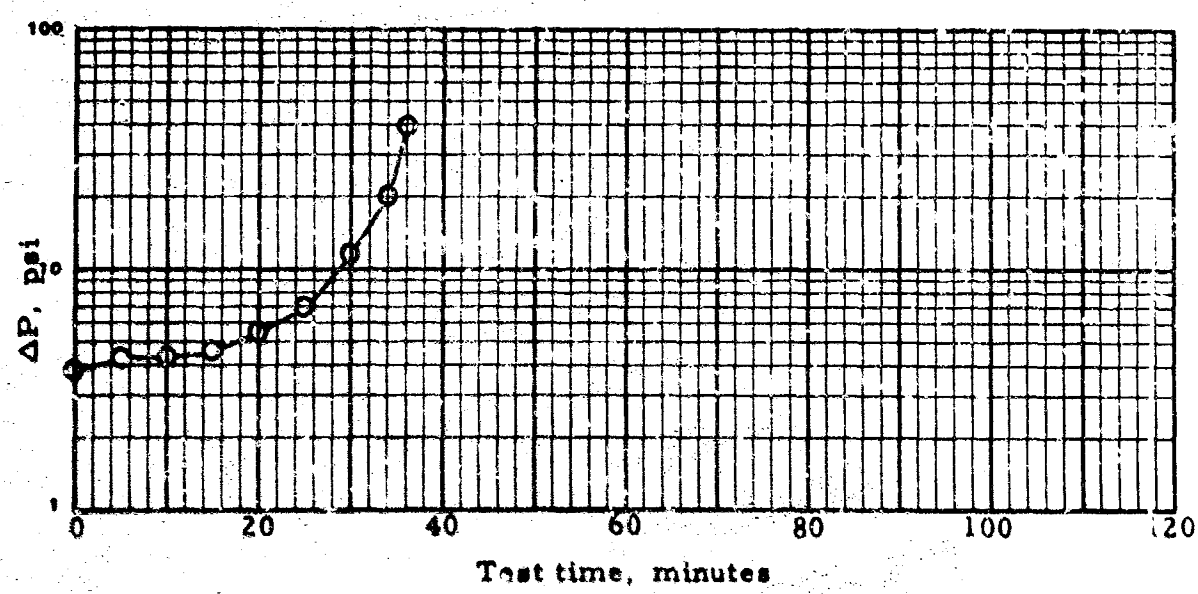
Time	Post-test
Solids, mg/liter	**
pH	7.5
ST, dyn/cm	72.9

* In this test, the pressure drop reached 40 psi before the end of the no-solids period; therefore, the second scheduled solids injection was not actually performed.

** Value obtained, 12.8 mg/liter, appeared erroneous since there was no visual evidence of any significant amount of solids (stain) on test filter.

TABLE 81 . SINGLE-ELEMENT LOOP TEST NO. 127 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.9	0	0			80
5	4.3	0	0	Neg.	0-1	80
10	4.3	0	0			80
15	4.7	0	0			80
20	5.5	0	0			80
25	7.0	0	0			80
30	11.8	0	0			80
34	20.0	0	1	0.14	0	80
36	40.0	0	2	0.16	11-12	80



Schedule:

Minutes	Water, gpm	Solids, g/min
0-34	0.002	5.72
34-36	0.2	----

TABLE 82 . SINGLE-ELEMENT LOOP TEST NO. 128 Date: 27 Sep 67

Loop no. 3 (Al/SS)		Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test. *

Test fuel JP-5 batch no. 18 , fresh
Date blended with additives: 26 Sep 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 16 lb/Mbbl, Santolene C , Lot [illegible]-006

Test duration, min	45	Calculated dirt loading, g	240
Fuel throughput, gal	903	Actual element weight gain, g	244
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	302	1205
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	57
IFT, distilled water, dyn/cm	35.9

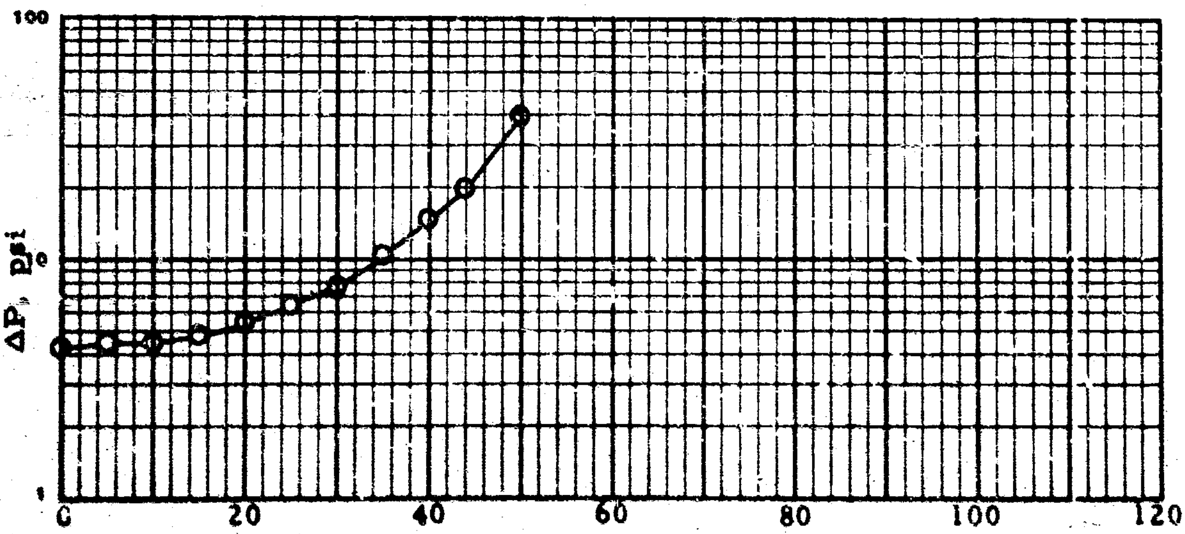
Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.5
ST, dyn/cm	70.5

* In this test, the pressure drop reached 40 psi before the end of the no-solids period; therefore, the second scheduled solids injection was not actually performed.

TABLE 82 . SINGLE-ELEMENT LOOP TEST NO. 128 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.2	0	0			79
5	4.5	0	0	0.02	0	79
10	4.5	0	0			79
15	4.9	0	0			79
20	5.5	0	0			79
25	6.4	0	0			79
30	7.9	0	0			79
35	10.5	0	0			79
40	15.5	2	0			79
42	20.0	3	0	0.39	1-2	79
45	39.6	4	0			79
45	40.0	4	0	0.14	20	79



Schedule:

Minutes	Water, gpm	Solids, g/min
0-42	0.002	5.72
42-45	0.2	----

TABLE 83 . SINGLE-ELEMENT LOOP TEST NO. 129 Date: 2 Oct 67

Loop no.	3 (Al/SS)	Housing:	8" I.D. aluminum
		Element	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no. 13-J		Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 19 , fresh
Date blended with additives: 2 Oct 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor None lb/Mbbl, , Lot

Test duration, min	76	Calculated dirt loading, g	349
Fuel throughput, gal	1538	Actual element weight gain, g	
Average rate, gpm	20.2		

Time	0 min	End test
Meter reading, gal	298	1830
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	2

Analyses on influent fuel:

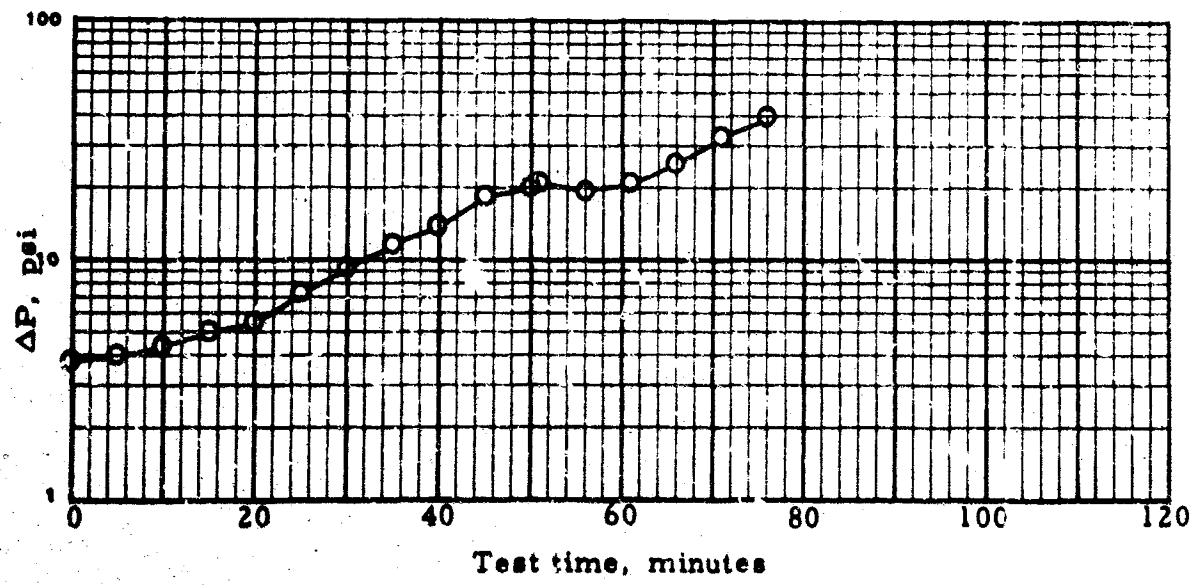
Time	Pre-test
WSIM, distilled water	85
IFT, distilled water, dyn/cm	41.9

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.6
ST, dyn/cm	70.3

TABLE 83 . SINGLE-ELEMENT LOOP TEST NO. 129 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.9	0	0			80
5	4.0	0	0	0.25	0	80
10	4.4	0	0			80
15	5.0	0	0			78
20	5.6	0	0			80
25	7.2	0	0			80
30	9.1	0	0			80
35	11.4	0	0			80
40	14.5	0	0			80
45	19.0	0	0			80
46	20.0	0	0	0.10	0	80
51	20.5	0	0	0.04	0-2	80
56	19.8	0	0		0-1	80
61	20.8	0	0		0-1	80
66	26.1	0	0			80
71	32.3	0	0			80
76	40.0	0	0	0.02	0-2	80



Schedule:

Minutes	Water, gpm	Solids, g/min
0-46	0.002	5.72
46-61	0.2	----
61-76	0.2	5.72

TABLE 84. SINGLE-ELEMENT LOOP TEST NO. 130 Date: 2 Oct 67

Loop no.	3 (A1/SS)	Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no. 13-J		Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 19, fresh
Date blended with additives: 2 Oct 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor None lb/Mbbl, , Lot

Test duration, min	88	Calculated dirt loading, g	418
Fuel throughput, gal	1759	Actual element weight gain, g	
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	307	2066
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	3

Analyses on influent fuel:

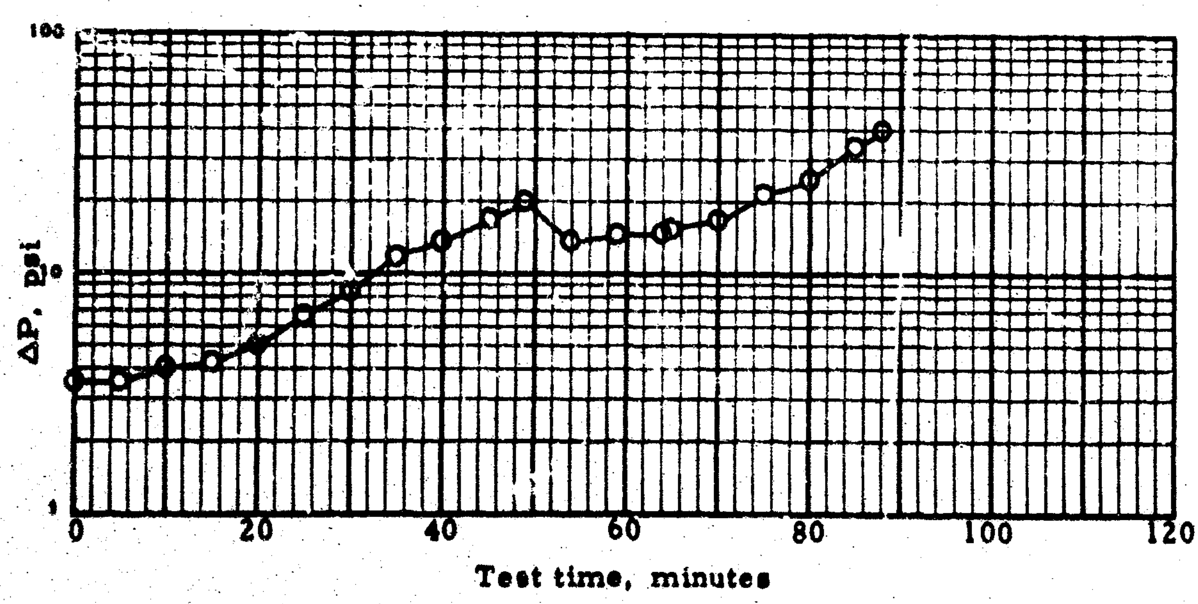
Time	Pre-test
WSIM, distilled water	82
IFT, distilled water, dyn/cm	43.6

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.6
ST, dyn/cm	72.2

TABLE 84 . SINGLE-ELEMENT LOOP TEST NO. 130 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.6	0	0			79
5	3.6	0	0	Neg.	0	80
10	4.0	0	0			80
15	4.3	0	0			80
20	5.0	0	0			80
25	6.8	0	0			80
30	8.5	0	0			80
35	11.0	0	0			80
40	13.4	0	0			80
45	17.0	0	0			80
49	20.0	0	0	Neg.	0-1	80
54	13.8	0	0	Neg.	0-1	80
59	14.0	0	0		0-1	80
64	14.0	0	0		0-1	80
65	15.0	0	0			80
70	17.5	0	0			80
75	21.0	0	0			80
80	26.5	0	0			80
85	34.0	0	0			80
88	40.0	0	0	0.02	3-5	80



Schedule:

Minutes	Water, gpm	Solids, g/min
0-49	0.002	5.72
49-64	0.2	----
64-88	0.2	5.72

TABLE 85. SINGLE-ELEMENT LOOP TEST NO. 131 Date: 3 Oct 67

Loop no.	3 (Al/SS)	Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	30
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued for 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 19, fresh
Date blended with additives: 3 Oct 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor None lb/Mbbl, , Lot

Test duration, min	87	Calculated dirt loading, g	412
Fuel throughput, gal	1753	Actual element weight gain, g	
Average rate, gpm	20.1		

Time	0 min	End test
Meter reading, gal	303	2056
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

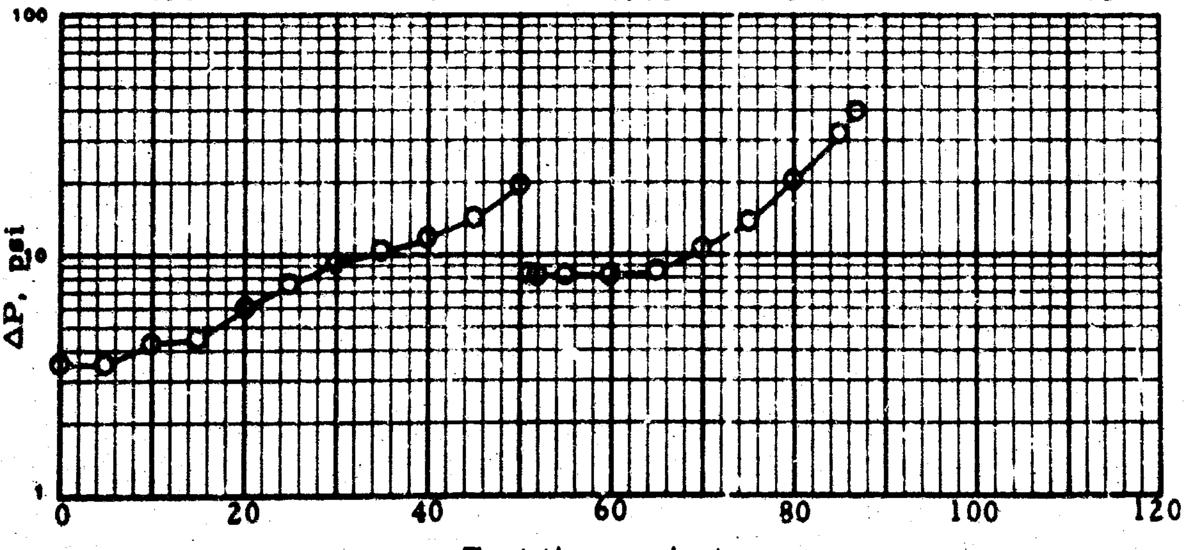
Time	Pre-test
WSIM, distilled water	79
IFT, distilled water, dyn/cm	44.6

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.8
pH	7.6
ST, dyn/cm	71.2

TABLE 85. SINGLE-ELEMENT LOOP TEST NO. 131 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.6	0	0			81
5	3.6	0	0	Neg.	0	81
10	4.3	0	0			81
15	4.6	0	0			81
20	6.0	0	0			81
25	7.7	0	0			81
30	9.2	0	0			81
35	10.3	0	0			81
40	12.1	0	0			81
45	15.3	0	0			81
50	20.0	0	0	Neg.	0	81
51	8.5	0	0			81
52	8.3	0	0			81
55	8.3	0	0	0.01	0-1	81
60	8.3	0	0		0	81
65	8.9	0	0		0-1	81
70	10.9	0	0			81
75	14.5	0	0			81
80	20.8	0	0			81
85	32.4	0	0			81
87	40.0	0	0	0.01	0-1	81



Schedule:

Minutes	Water, gpm	Solids, g/min
0-50	0.002	5.72
50-65	0.2	----
65-87	0.2	5.72

TABLE 86. SINGLE-ELEMENT LOOP TEST NO. 132 Date: 4 Oct 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no. 13-A		Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Coarse AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm starting at 0 min to 20 psi, then 0.2 gpm to end of test. *

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 19 , fresh
Date blended with additives: 4 Oct 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 14.5 lb/Mbbl, Na-Sul EDS , Lot 27-640

Test duration, min	29	Calculated dirt loading, g	160
Fuel throughput, gal	591	Actual element weight gain, g	190
Average rate, gpm	20.4		

Time	0 min	End test
Meter reading, gal	304	895
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	2

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	11
IFT, distilled water, dyn/cm	15.1

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.4
ST, dyn/cm	72.1

* In this test, the pressure drop reached 40 psi before the end of the 15-minute no-solids period; therefore, the second scheduled solids injection was not actually performed.

TABLE 86. SINGLE-ELEMENT LOOP TEST NO. 132 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.6	0	0			81
5	4.5	0	0	0.10	0-1	78
10	4.5	0	1			80
15	5.8	0	4			79
20	7.3	0	8			80
25	11.7	0	17			80
28	20.0	0	33	7.47	20+	80
29	40.0	0	100		20+	80

Schedule:

Minutes	Water, gpm	Solids, g/min
0-28	0.002	5.72
28-29	0.02	----

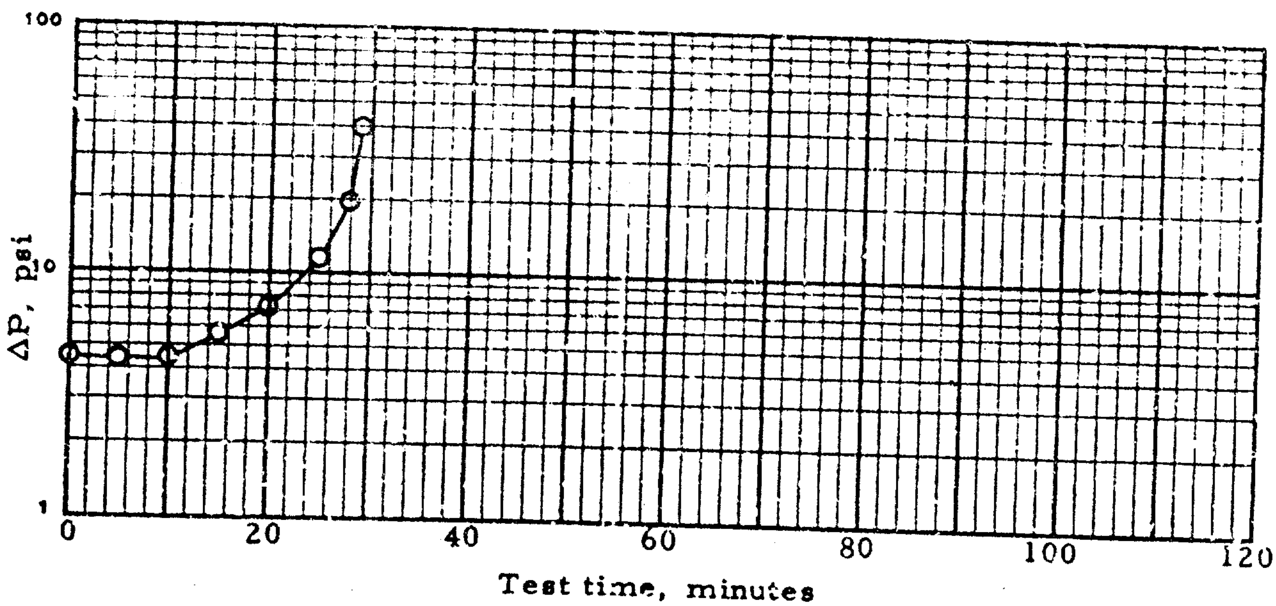


TABLE 87. SINGLE-ELEMENT LOOP TEST NO. 133 Date: 5 Oct 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Coarse AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min starting at 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 19 , fresh
Date blended with additives: 5 Oct 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 14.5 lb/Mbbl, Na-Sul EDS , Lot 27-640

Test duration, min	54	Calculated dirt loading, g	223
Fuel throughput, gal	1093	Actual element weight gain, g	228
Average rate, gpm	20.2		

Time	0 min	End test
Meter reading, gal	328	1421
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	11
IFT, distilled water, dyn/cm	14.9

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.4
ST, dyn/cm	71.3

TABLE 87. SINGLE-ELEMENT LOOP TEST NO. 133 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.9	0	0			
5	4.1	0	0			80
10	4.3	0	2		0	80
15	4.5	0	7			80
20	5.5	0	5		4-5	80
25	7.4	0	5			80
30	10.0	0	14			80
35	15.3	0	14		20	80
38	20.0	0	25			80
43	21.7	0	40		20+	80
48	27.2	0	55	0.82	20+	80
53	32.3	0	70		20+	80
54	40.0	0	74		20+	80
				0.71	20+	80

Schedule:

Minutes	Water, gpm	Solids, g/min
0-38	0.002	5.72
38-53	0.2	----
53-54	0.2	5.72

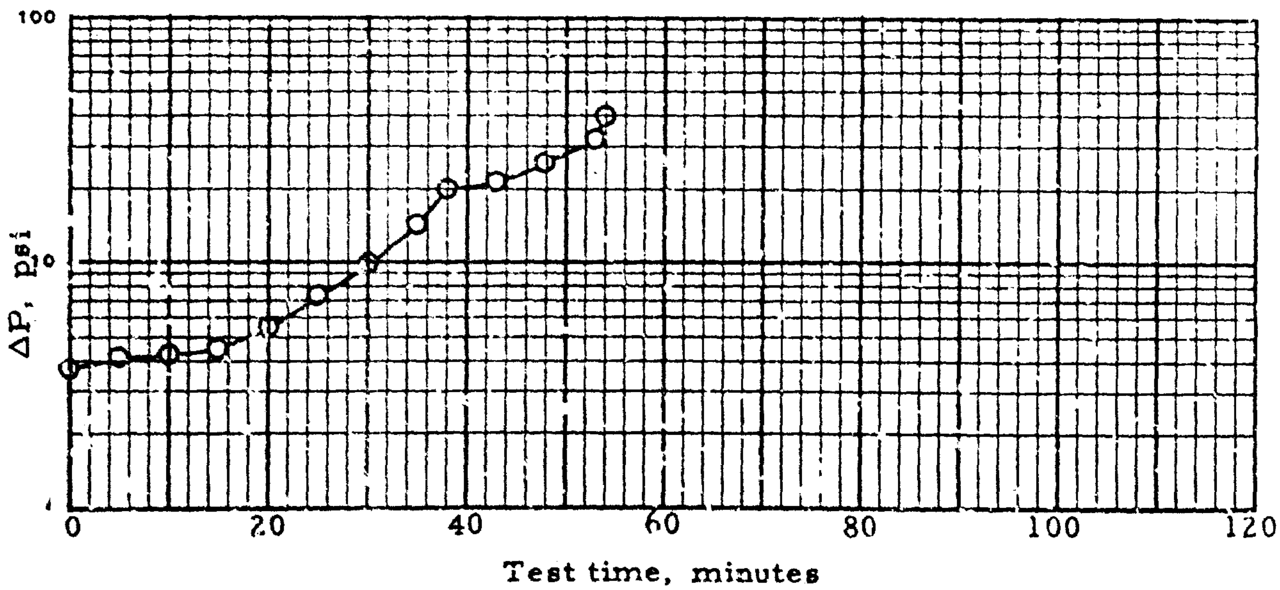


TABLE 88. LOOP TEST NO. 134 Date: 6 October 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 19 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot 0306720	0.15	vol. %
Corrosion inhibitor, Na-Sul EDS Lot 27-640	14.5	lb/Mbbl

Fuel inlet temperature, °F	80	Fuel throughput, gal	100
Test duration, min	5	Avg. flow rate, gpm	20.0

Actual element weight gain, g -0.4
Calculated dirt loading, g 0

		Pre-test	5 min	95 min
Influent fuel	Solids, mg/liter	Neg.		
	WSIM, dist. water	10		
	WSIM, inj. water	10		
	IFT, dist. water, dyn/cm	12.2		
	IFT, inj. water, dyn/cm	8.9		
	FSII content, vol. %	0.12		
Injection water	Solids, mg/liter		0.1	
	pH		8.3	
	ST, dyn/cm		72.7	
Coalesced water	pH			
	ST, dyn/cm			
	FSII content, vol. %			

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	1						1
Cleanup ΔP, psi	0						0
Throughput, gal	305						405

TABLE 88. LOOP TEST NO. 134(Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	5.0			0
2	5.8	a	20+	100+
5	6.6	Neg.	20+	100+

a. Totamitor began to climb after 30 sec test time and continued to a reading of 100+ at 1 min.

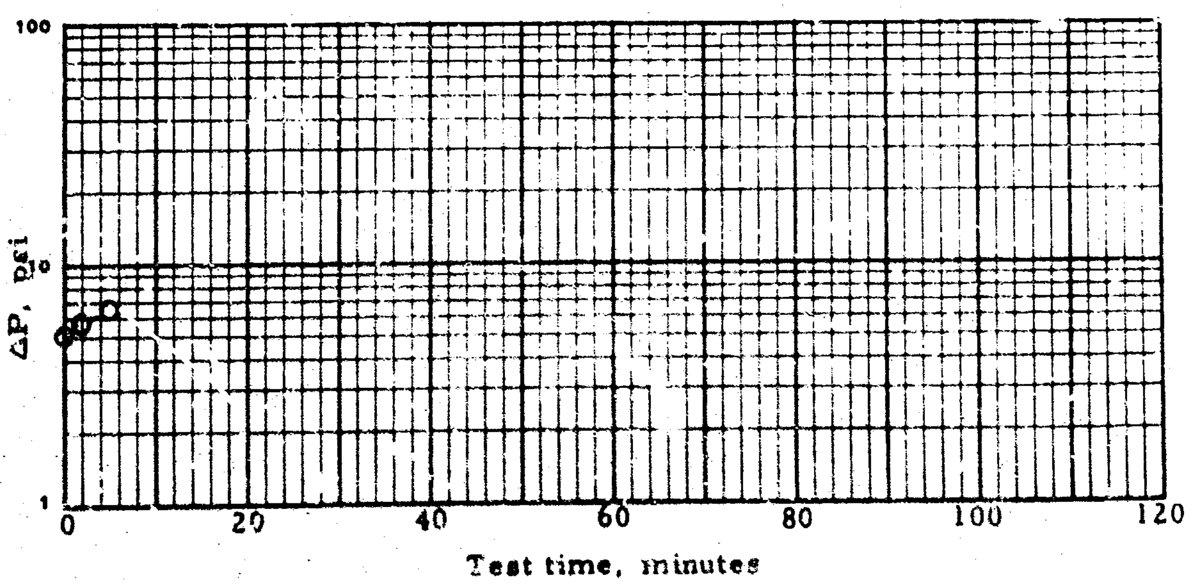


TABLE 89. SINGLE-ELEMENT LOOP TEST NO. 135 Date: 9 Oct 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type I

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test. *

Test fuel JP-5 batch no. 19 , fresh
Date blended with additives: 9 Oct 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 14.5 lb/Mbbl, Na-Sul EDS , Lot 27-640

Test duration, min	17	Calculated dirt loading, g	97
Fuel throughput, gal	345	Actual element weight gain, g	84
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	302	647
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	12
IFT, distilled water, dyn/cm	11.9

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.3
ST, dyn/cm	72.2

* In this test, the pressure drop reached 40 psi before the end of the 15-minute no-solids period; therefore, the second scheduled solids injection was not actually performed.

TABLE 89. SINGLE-ELEMENT LOOP TEST NO. 135 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	5.0	0	0			80
5	5.5	0	4	1.62(a)	4-5	80
10	8.2	0	8			80
12	10.0	0	11	3.37(a)		80
15	15.5	0	14			80
17	20.0	0	17	15.70(a)	20++	80
17.25	40.0	0	100		20++	80

(a) AC dust on pad.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-17	0.002	5.72
17-17.25	0.2	----

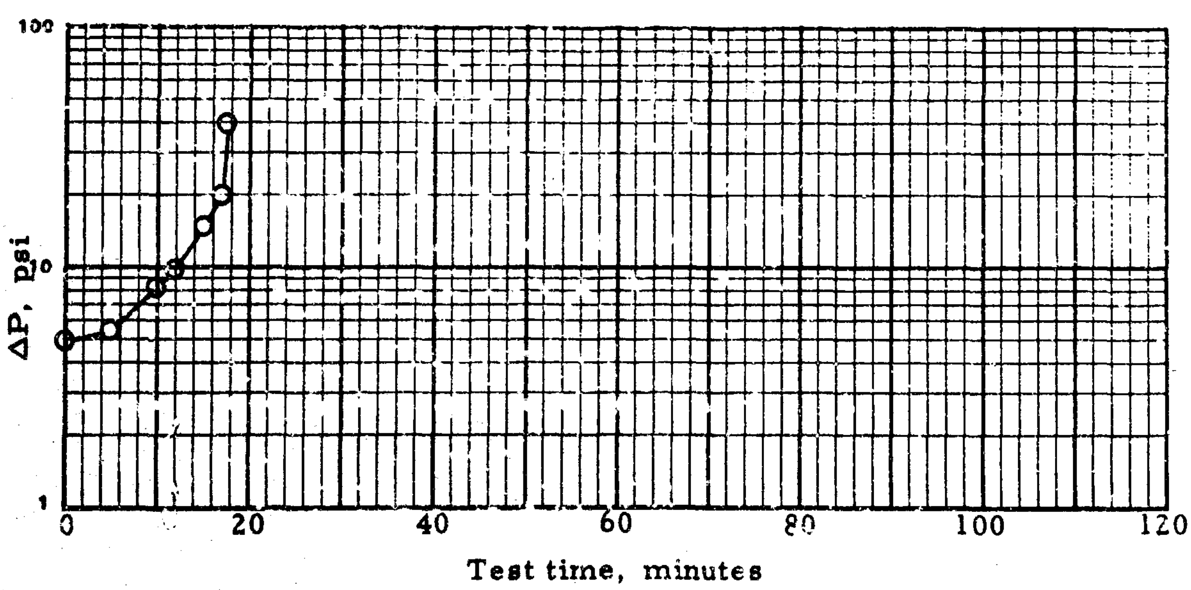


TABLE 90. SINGLE-ELEMENT LOOP TEST NO. 136 Date: 10 Oct 67

Loop no. 3 (Al/SS)

Housing: 8" I. D. aluminum
Element: Filters Inc. I-4208 Lot 440
Canister: DoD Type 1

Procedure no. 13-A
Water: Filtered tap water
Solids: Coarse AC dust

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm starting at 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 19 , fresh
Date blended with additives: 10 Oct 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 9 lb/Mbbl, Unicor M , Lot 0020

Test duration, min	50
Fuel throughput, gal	982
Average rate, gpm	19.8

Calculated dirt loading, g	200
Actual element weight gain, g	181

Time	0 min	End test
Meter reading, gal	307	1289
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	41
IFT, distilled water, dyn/cm	24.2

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.5
ST, dyn/cm	71.3

TABLE 90. SINGLE-ELEMENT LOOP TEST NO. 136 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.4	0	0			80
5	4.5	0	0	0.14	0	80
10	4.7	0	0			80
15	6.4	0	0			80
20	8.9	0	0			80
25	12.3	0	0			80
30	18.8	0	0			80
31	20.0	0	0(a)	0.07	1-2	80
36	20.9	0	0	Neg.	1-2	80
41	20.5	0	0		0-1	80
46	20.6	0	0		1-2	80
50	40.0	0	0	0.08	1-2	80

(a) Effluent Totamitor reading of 3 prior to build up of water seal in housing.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-31	0.002	5.72
31-46	0.2	----
46-50	0.2	5.72

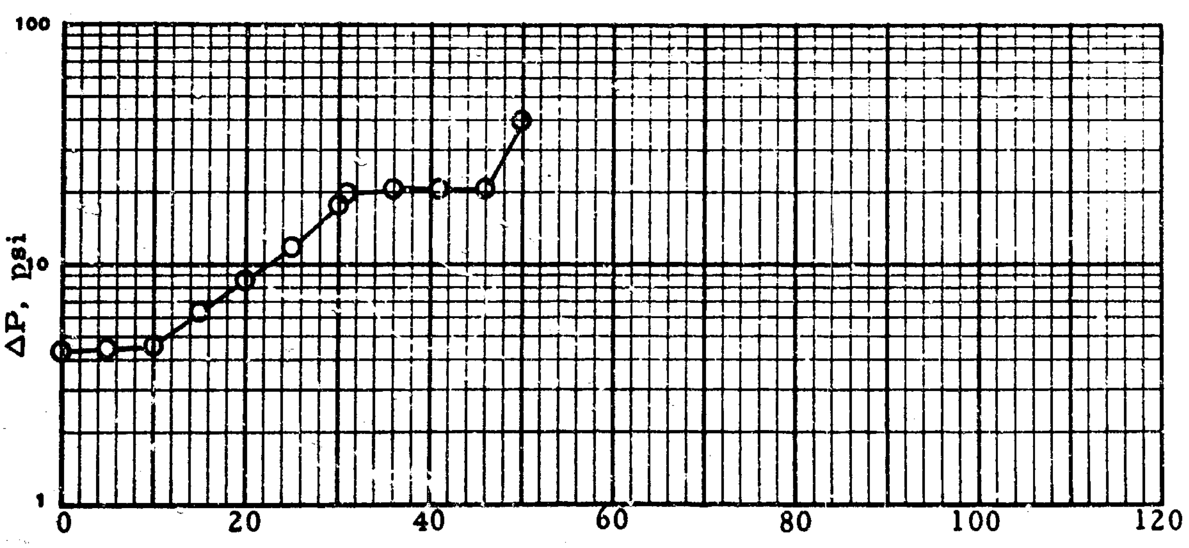


TABLE 91. SINGLE-ELEMENT LOOP TEST NO. 137 Date: 11 Oct 67

Loop no. 3 (Al/SS)

Housing: 8" I. D. aluminum
Element: Filters Inc. I-4208 Lot 440
Canister: DoD Type 1

Procedure no. 13-A
Water: Filtered tap water
Solids: Coarse AC dust

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm starting at 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test. *

Test fuel JP-5 batch no. 19 , fresh
Date blended with additives: 11 Oct 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, Unicor M , Lot 0020

Test duration, min	52
Fuel throughput, gal	1013
Average rate, gpm	19.5

Calculated dirt loading, g	230
Actual element weight gain, g	229

Time	0 min	End test
Meter reading, gal	300	1313
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	23
IFT, distilled water, dyn/cm	12.3

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.2
ST, dyn/cm	71.9

* In this test, the pressure drop reached 40 psi before the end of the 15-minute no-solids period; therefore, the second scheduled solids injection was not actually performed.

TABLE . 91. SINGLE-ELEMENT LOOP TEST NO. 137 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.9	0	0			80
5	3.9	0	0	0.02	0	80
10	4.1	0	0			80
15	4.5	0	0			80
20	5.2	0	0			80
25	7.4	0	0			80
30	10.4	0	0			80
35	12.1	0	0			80
40	19.5	0	0			80
40.2	20.0	0	7(a)	Neg.	2-3	80
45	36.3	0	5	0.04	7-9	80
50	39.5	0	8		8-10	80
52	40.0	0	8	0.05	10-12	80

(a) Maximum Totamitor reading of 7 after 30 seconds after start of 0.2 gpm water injection, then dropped down to a reading of 3.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-40.2	0.002	5.72
40.2-50	0.2	----

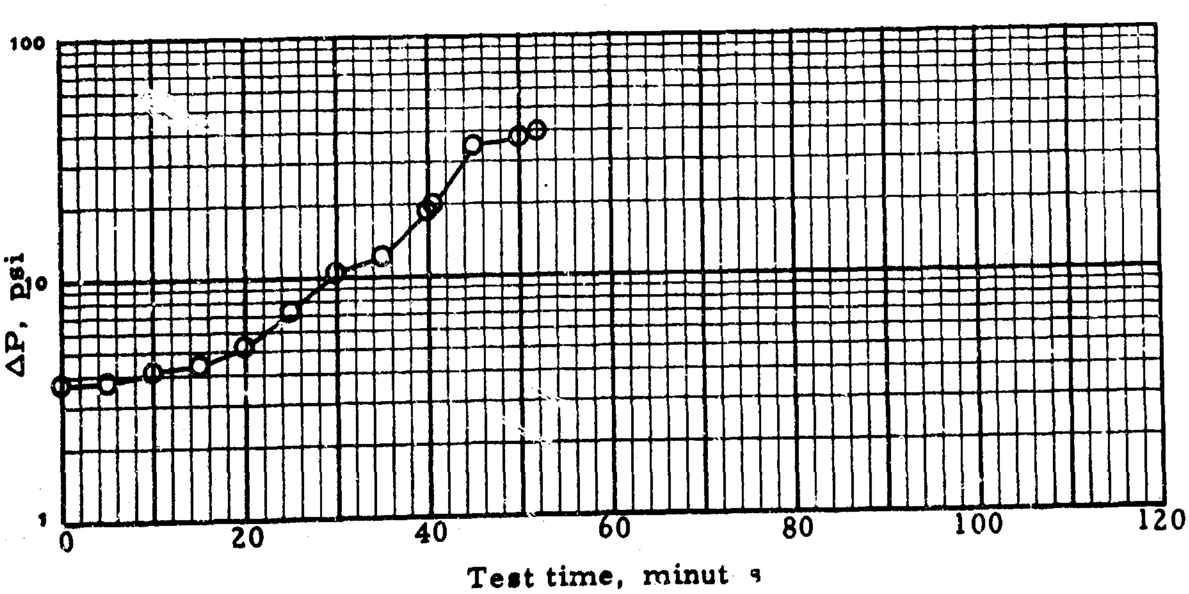


TABLE 92. LOOP TEST NO. 138 Date: 11 October 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Type B synthetic water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 19 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 0306720 0.15 vol. %
Corrosion inhibitor, Unicor M, Lot 0020 20 lb/Mbbl

Fuel inlet temperature, °F 79-82 Fuel throughput, gal 1833
Test duration, min 91 Avg. flow rate, gpm 20.1

Actual element weight gain, g 166
Calculated dirt loading, g 177

		Pre-test	30 min	87 min
Influent fuel	Solids, mg/liter	0.28	0.17	0.06
	WSIM, dist. water	26		
	WSIM, inj. water	27		22
	IFT, dist. water, dyn/cm	23.4		
	IFT, inj. water, dyn/cm	18.2		21.6
	FSII content, vol. %	0.15		0.04
Injection water	Solids, mg/liter		0.00	
	pH		8.4	8.4
	ST, dyn/cm		72.3	72.7
Coalesced water	pH		8.2	
	ST, dyn/cm		31.2	61.7
	FSII content, vol. %		a	2.0

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0				0
Cleanup ΔP, psi	0	0	0				0
Throughput, gal	309	900	1511				2142

a. Sample too cloudy for analysis.

TABLE 92. LOOP TEST NO. 138 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	5.0			0
10	5.4			0
20	5.6			0
30	6.3	0.05	1-2	0
40	6.0			0
50	6.2			0
60	6.2			0
70	7.2			0
80	11.4			0
87	20.0	0.12	1-2	0
90	34.0			0
91	40.0	0.09	11-12	0

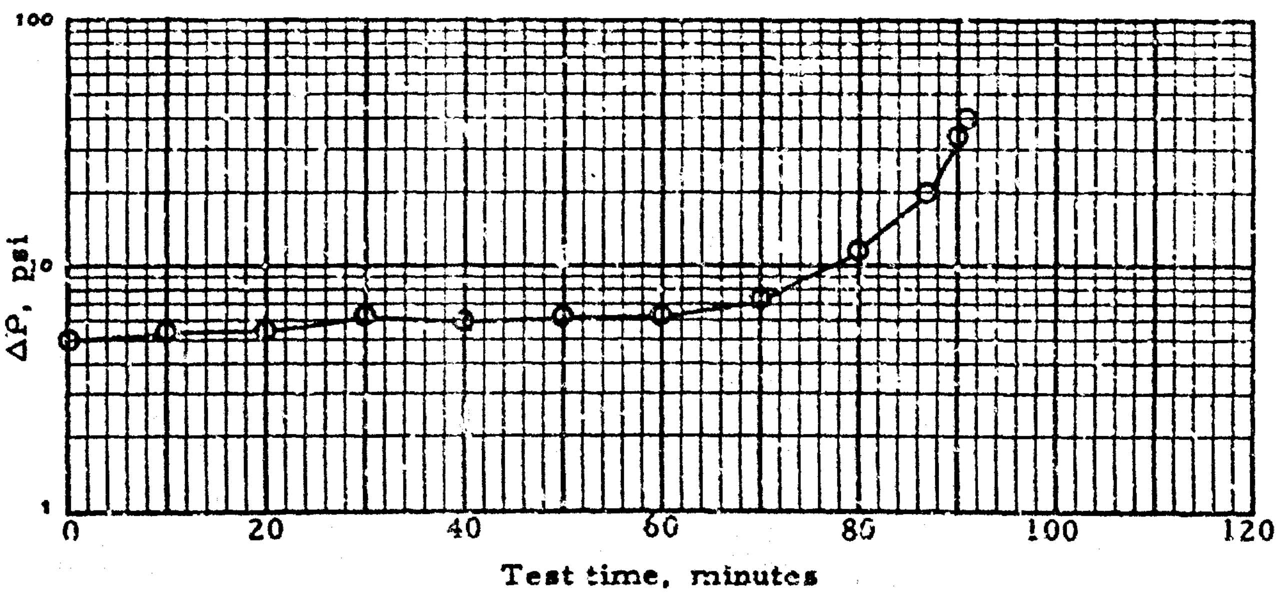


TABLE 93. SINGLE-ELEMENT LOOP TEST NO. 139 Date: 12 Oct 67

Loop no. 3 (Al/SS)

Housing: 8" I. D. aluminum
Element: Filters Inc. I-?208 Lot 440
Canister: DoD Type 1

Procedure no. 13-J
Water: Filtered tap water
Solids: Fine AC dust

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm starting at 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued for 15 min, then 5.72 g/min to end of test.*

Test fuel JP-5 batch no. 19, fresh
Date blended with additives: 12 Oct 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, Unicor M, Lot 0020

Test duration, min 28
Fuel throughput, gal 554
Average rate, gpm 20

Calculated dirt loading, g 154
Actual element weight gain, g 151

Time	0 min	End test
Meter reading, gal	300	854
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	27
IFT, distilled water, dyn/cm	30.2

Analyses on injection water:

Time	Post-test
Solids, mg/liter	Neg.
pH	7.5
ST, dyn/cm	72.4

* In this test, the pressure drop reached 40 psi before the end of the 15-minute no-solids period; therefore, the second scheduled solids injection was not actually performed.

TABLE 93. SINGLE-ELEMENT LOOP TEST NO. 139 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.3	0	0			80
5	3.8	0	0	0.08	0	80
10	4.2	0	0			80
15	5.0	0	0			80
20	7.4	0	0			80
25	14.7	0	0			80
27	20.0	0	0	1.31(a)	0	80
28	40+	0	7		5-6	80

(a) Represents both 20 and 40 psi (time difference only 1 min). AC dust visible on membrane filter.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-27	0.002	5.72
27-28	0.2	----

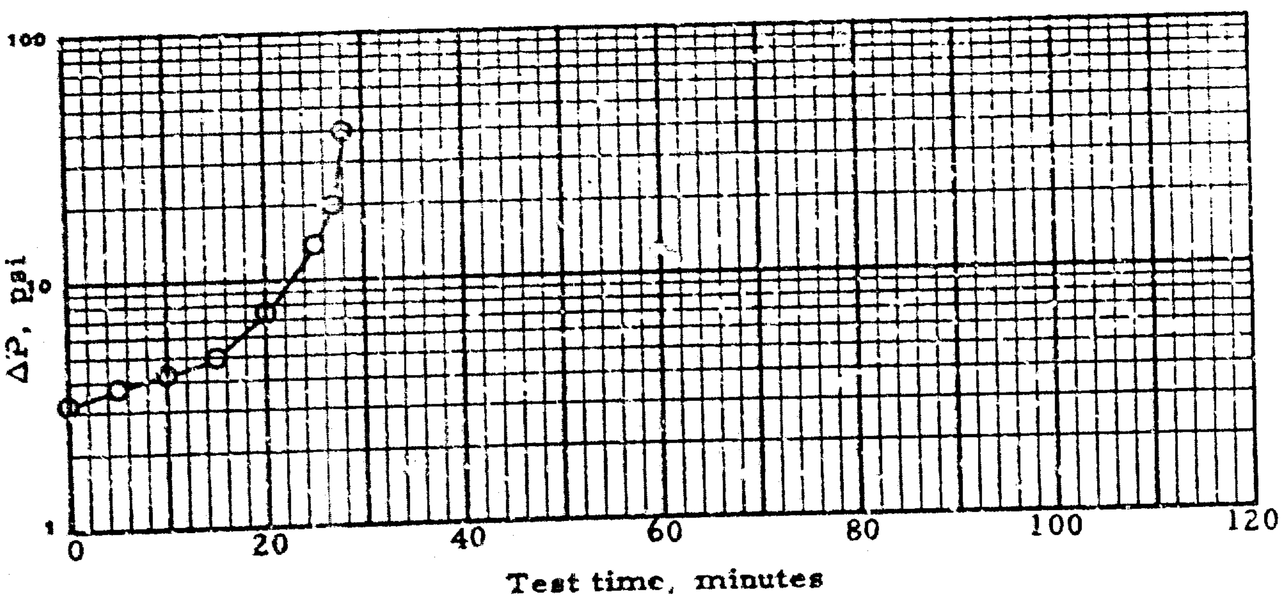


TABLE 94. SINGLE-ELEMENT LOOP TEST NO. 140 Date: 13 Oct 67

Loop no. 3 (Al/SS)

Housing: 8" I. D. aluminum
Element: Filters Inc. 1-4208 Lot 440
Canister: DoD Type 1

Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Coarse AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm starting at 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued for 15 min, then 5.72 g/min to end of test. *

Test fuel JP-5 batch no. 19, fresh
Date blended with additives: 12 Oct 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 5.5 lb/Mbbl, Tolad 244, Lot 47-12

Test duration, min	52	Calculated dirt loading, g	212
Fuel throughput, gal	1040	Actual element weight gain, g	228
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	300	1340
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	64
IFT, distilled water, dyn/cm	35.2

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.4
ST, dyn/cm	72.4

* In this test, the pressure drop reached 40 psi before the end of the 15-minute no-solids period; therefore, the second scheduled solids injection was not actually performed.

TABLE 94. SINGLE-ELEMENT LOOP TEST NO. 140 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.8	0	0			80
5	3.8	0	0	0.24	0	80
10	4.0	0	0			80
15	4.9	0	0			80
20	7.0	0	0			80
25	9.7	0	0			80
30	13.5	0	0			80
34	20.0	0	0	0.18	0	80
39	21.8	0	2(a)	0.15	2-3	80
44	21.9	0	6		12-14	80
49	21.8	0	3		2-3	80
52	40.0	0	6	0.66	4-5	80

(a) At 39 min, effluent Totamitor reached a reading of 73 because of flooding of test housing. Draining of test housing at 43 min reduced Totamitor reading to 3.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-34	0.002	5.72
34-49	0.2	----
49-52	0.2	5.72

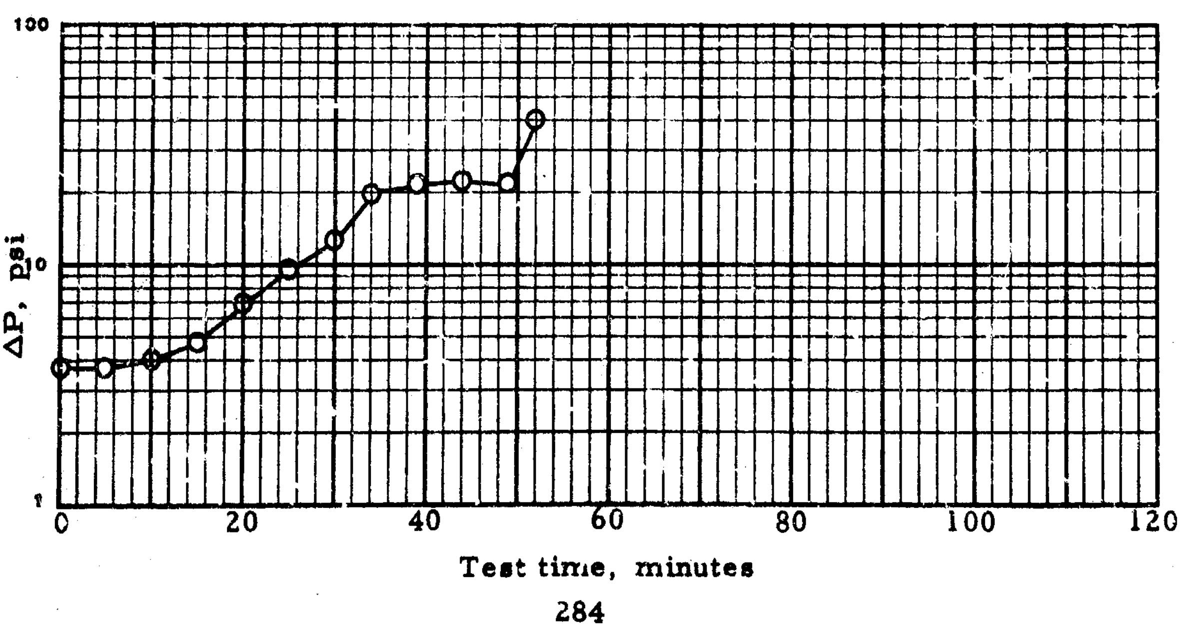


TABLE 95. SINGLE-ELEMENT LOOP TEST NO. 141 Date: 13 Oct 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type I

Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Coarse AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued for 15 min., then 5.72 g/min to end of test.*

Test fuel JP-5 batch no. 19 , fresh
Date blended with additives: 13 Oct 67
Anti-icing additive 0.15 vol. %, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, Tolad 244 , Lot No. 47-12

Test duration, min	40	Calculated dirt loading, g	154
Fuel throughput, gal	807	Actual element weight gain, g	169
Average rate, gpm	20.2		

Time	0 min	End test
Meter reading, gal	289	1096
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	28
IFT, distilled water, dyn/cm	25.1

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.4
ST, dyn/cm	71.0

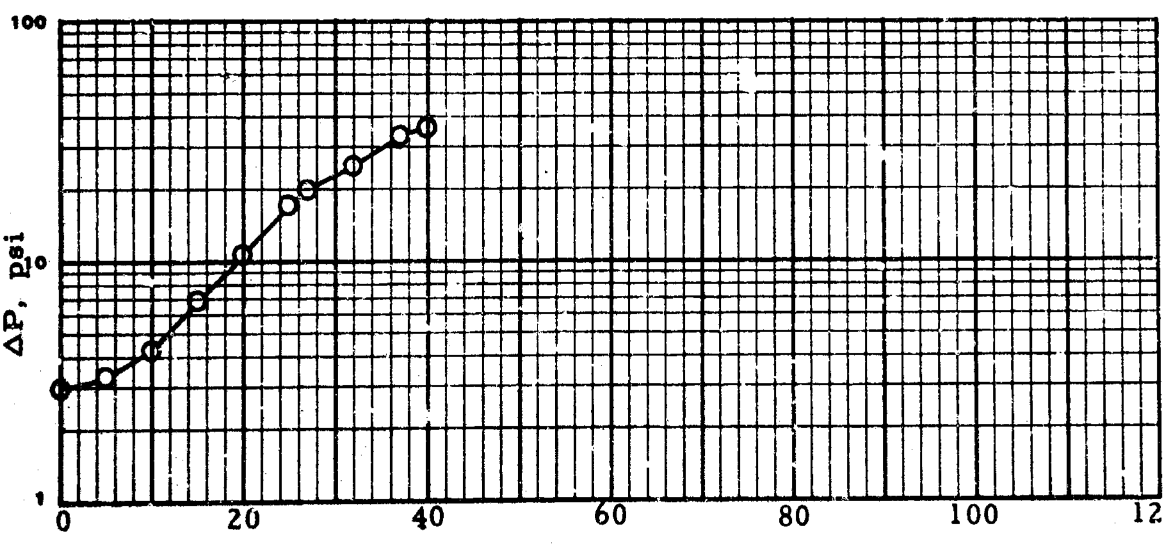
* In this test, the pressure drop reached 40 psi before the end of the 15-minute no-solids period; therefore, the second scheduled solid injection was not actually performed.

TABLE 95. SINGLE-ELEMENT LOOP TEST NO. 141 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.0	0	0			80
5	3.3	0	1	0.10	0	80
10	4.1	0	1			80
15	7.0	0	1			80
20	10.4	0	1			80
25	17.3	0	0			80
27	20.0	0	0(a)	0.04	0-1	80
32	26.6	0	33	0.16(b)	10-11	80
37	33.9	0	60		18-19	80
40	37.1	0	100+	0.14(b)	20+++	80

(a) Effluent Totamitor reading 5 after water injection was increased to 0.2 gpm and continued climbing to end of test.

(b) Entire fuel sample not filtered, since membrane filter plugged. True solids contents probably higher than indicated.



Schedule:	Minutes	Water, gpm	Solids, g/min
	0-27	0.002	5.72
	27-40	0.2	---

TABLE 96. SINGLE-ELEMENT LOOP TEST NO. 142 Date 16 Oct 67

Loop No. 3 (Al/SS), Housing 8" I.D. aluminum
Element. Filters Inc. I-4208 Lot 440 with DoD canister, type I

PROCEDURE: Modified MIL-F-8901A inhibited-fuel test (Procedure No. 10)
Fuel flow 20 gpm, fuel inlet temperature 80 °F, inlet pressure 70 psi
Water injection 0.2 gpm, solids injection 5.72 g/min starting at 60 min
Test duration 15 min, fuel throughput 298 gal, avg. rate 20.0 gpm

TEST FUEL: JP-5 Batch No. 19 , fresh (X) or from preceding test ( )
Anti-icing additive 0.15 % (vol.), Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl of Tolad 244 Lot 47-12
Other fuel additives:

Water composition: Filtered tap water
Solids: Coarse AC dust

ANALYSES:		Pre-test	15 ~~XX~~ min	95 min
Influent fuel:	Solids, mg/liter	0.14		
	WSIM, distilled water	29		
	WSIM, injection water	23		
	IFT, distilled water, dyn/cm	26.3		
	IFT, injection water, dyn/cm	15.5		
	AIA content, vol. %	0.13		
	Other analyses:			
Injection water:	Solids, mg/liter		0.2	
	pH		7.4	
	ST, dyn/cm		70.8	
Coalesced water:	pH			
	ST, dyn/cm			
	AIA content, vol. %			

Calculated dirt loading, g 0
Actual element weight gain, g 0

REMARKS

Fuel blended 16 Oct 67

TABLE 96. SINGLE-ELEMENT LOOP TEST NO. 142 (Contd.)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Remarks
0	3.6	0	0			
3	4.7	0	3		2-3	
10	5.1	0	5		9-10	(a)
15	6.0	0	100+	0.82		(b)

(a) Turbulence was observed in test housing at fuel-water interface just before test was stopped.

(b) Effluent sample (solids sample) cloudy.

Time, min	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	1						1
Cleanup ΔP, psi	0						0
Throughput, gal	297						595

TABLE 97. LOOP TEST NO. 143 Date: 16 October 1967

Al/SS loop with 8" I. D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Filtered tap water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 19 plus additives as shown.

(X) Fresh-fuel blend OR ( ) Fuel from previous test

Fuel system icing inhibitor, Dow, Lot	0306720	0.15 vol. %
Corrosion inhibitor, Tolad 244 Lot	4[illegible]-12	20 lb/Mbbl

Fuel inlet temperature, °F	80	Fuel throughput, gal	265
Test duration, min	14	Avg. flow rate, gpm	19.0

Actual element weight gain, g	0
Calculated dirt loading, g	0

		Pre-test	14 min
Influent fuel	Solids, mg/liter	1.0[a]	
	WSIM, dist. water	31	
	WSIM, inj. water	20	
	IFT, dist. water, dyn/cm	25.6	
	IFT, inj. water, dyn/cm	15.2	
	FSII content, vol. %	0.12	
Injection water	Solids, mg/liter		0.3
	pH		7.9
	ST, dyn/cm		71.3
Coalesced water	pH		
	ST, dyn/cm		
	FSII content, vol. %		

Time, min:	Pre-test	30	60	95	130	150	End
Screen ΔP, psi	0						0
Cleanup ΔP, psi	0						0
Throughput, gal	294						559

a. No visible evidence of any solids on test filter; significant weight loss of control filter gave high solids value.

TABLE 97. LOOP TEST NO. 143 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitcr Reading
0	3.3			0
3	4.1		2-3	4
10	4.5		2-3	6
11	5.0	0.28	20+++	100+
14	5.0			100+

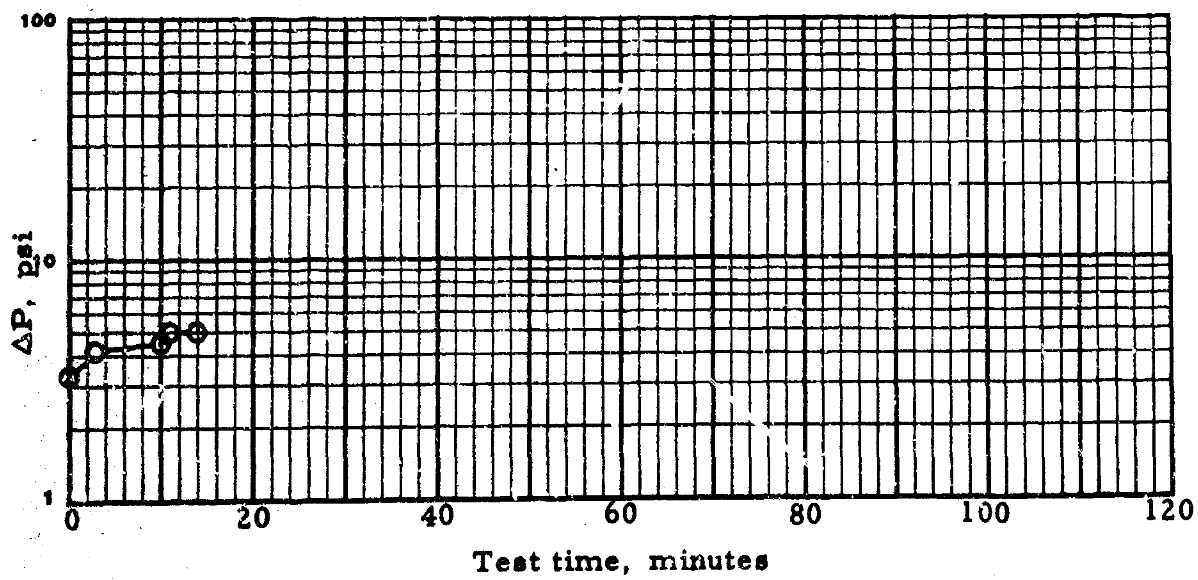


TABLE 98. SINGLE-ELEMENT LOOP TEST NO. 144 Date: 18 Oct 67

Loop no. 3 (Al/SS)

Housing: 8" I. D. aluminum
Element: Filters Inc. I-4208 Lot 440
Canister: DoD Type 1

Procedure no. 13-A
Water: Filtered tap water
Solids: Coarse AC dust

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 19, fresh
Date blended with additives: 16 Oct 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 5.5 lb/Mbbl, Tolad 244, Lot 47-12

Test duration, min 51
Fuel throughput, gal 1023
Average rate, gpm 19.9

Calculated dirt loading, g 206
Actual element weight gain, g 196

Time	0 min	End test
Meter reading, gal	329	1352
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	58
IFT, distilled water, dyn/cm	35.8

Analyses on injection water:

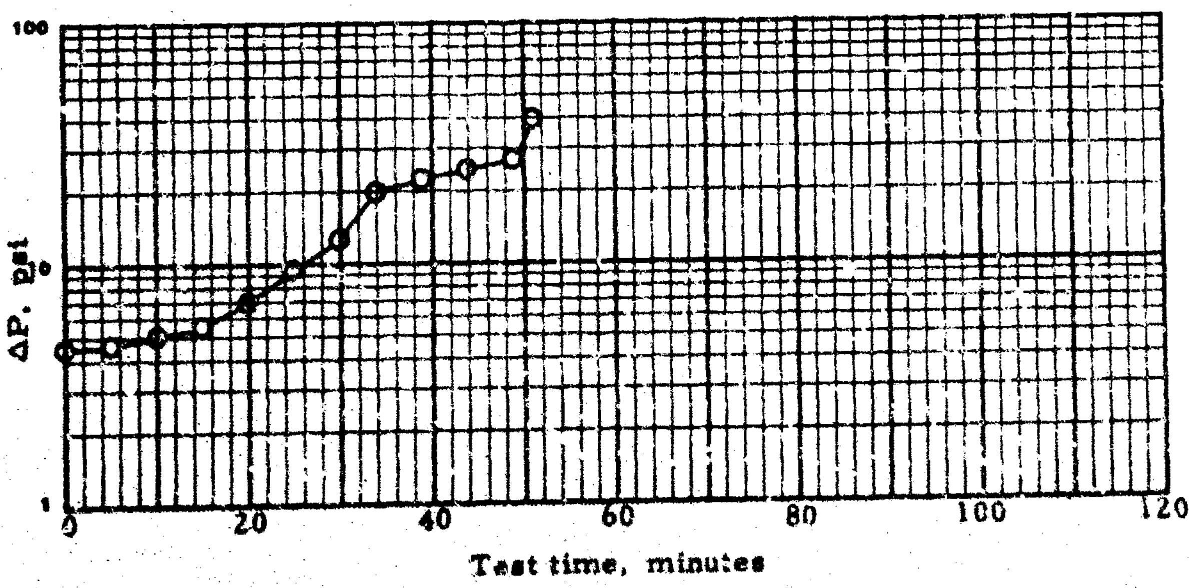
Time	Post-test
Solids, mg/liter	0.1
pH	7.5
ST, dyn/cm	71.9

TABLE 98. SINGLE-ELEMENT LOOP TEST NO. 144 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.5	0	0			80
5	4.7	0	0	0.04	0	80
10	5.0	0	0			80
15	5.5	0	0			80
20	7.0	0	0			80
25	9.6	0	0			80
30	13.6	0	0			80
34	20.0	0	0(a)	0.68	0-1	80
39	23.5	0	2	0.53	2-3	80
44	25.1	0	5		4-5	80
49	27.0	0	9		8-9	80
51	40.0	0	15	1.48(b)	18-20	80

(a) Effluent Totamitor reading began increasing up to 5 after 30 sec.

(b) AC dust visible on test filter.



Schedule:	Minutes	Water, gpm	Solids, g/min
	0-34	0.002	5.72
	34-49	0.2	---
	49-51	0.2	5.72

TABLE 99. SINGLE-ELEMENT LOOP TEST NO. 145 Date: 18 Oct 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued for 15 min, then 5.72 g/min to end of test.*

Test fuel JP-5 batch no. 19 , fresh
Date blended with additives: 18 Oct 67
Anti-icing additive 0.15 vol.%, Dow, Lot 0306720
Corrosion inhibitor 20 lb/Mbbl, Tolad 244 , Lot 47-12

Test duration, min	22	Calculated dirt loading, g	120
Fuel throughput, gal	457	Actual element weight gain, g	112
Average rate, gpm	20.8		

Time	0 min	End test
Meter reading, gal	297	754
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	2

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	32
IFT, distilled water, dyn/cm	24.5

Analyses on injection water:

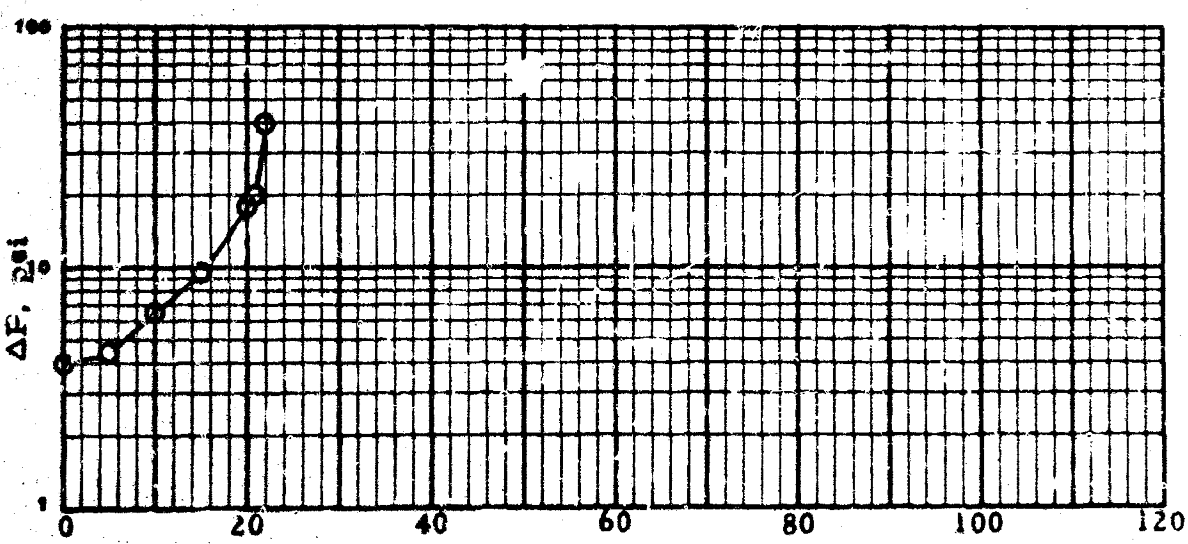
Time	Post-test
Solids, mg/liter	0.0
pH	7.6
ST, dyn/cm	70.6

* In this test, the pressure drop reached 40 psi before the end of the 15-minute no-solids period; therefore, the second scheduled solid injection was not actually performed.

TABLE 99. SINGLE-ELEMENT LOOP TEST NO. 145 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.0	0	0			80
5	4.4	0	2	0.93(a)	1-2	81
10	6.5	0	5	2.62(a)	2-3(a)	81
15	9.5	0	5			80
20	18.4	0	5			80
21	20.0	0	5	4.25(a)	3-4(a)	80
22	40.0	0	94	4.10(a)	20+(a)	80

(a) AC dust visible on test filters.



Schedule:	Minutes	Water, gpm	Solids, g/min
	0-21	0.002	5.72
	21-22	0.2	---

TABLE 100. SINGLE-ELEMENT LOOP TEST NO. 146 Date: 19 Oct 67

Loop no. 3 (Al/SS)

Housing: 8" I.D. aluminum
Element: Filters Inc. I-4208 Lot 440
Canister: DoD Type 1

Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80*
Solids:	Coarse AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.27 g/min from 0 min to 20 psi, then discontinued for 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 19 , fresh
Date blended with additives: 19 Oct 67
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 5 lb/Mbbl, Lubrizol 541 , Lot 24794

Test duration, min	48	Calculated dirt loading, g	194
Fuel throughput, gal	943	Actual element weight gain, g	189
Average rate, gpm	19.7		

Time	0 min	End test
Meter reading, gal	331	1274
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	2

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	62
IFT, distilled water, dyn/cm	33.3

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.6
ST, dyn/cm	72.2

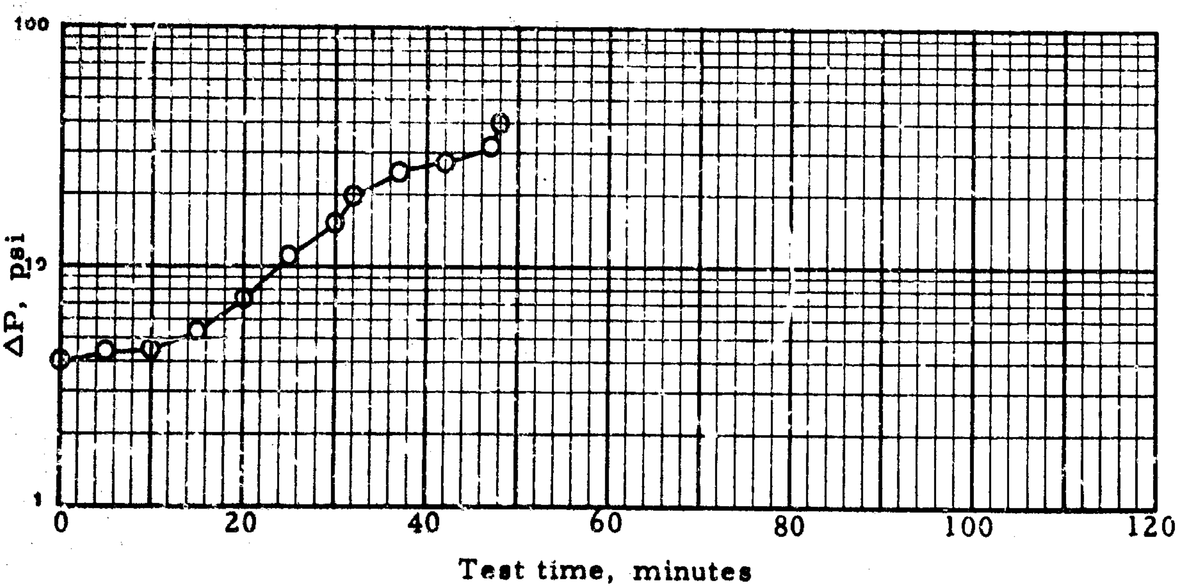
* Temperature 34°F at 0 min, but adjusted to 80±1°F within 5 min.

TABLE 100. SINGLE-ELEMENT LOOP TEST NO. 146 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.0	0	0			84
5	4.4	0	0	0.39	0	79
10	4.5	0	1			80
15	5.3	0	1			79
20	7.3	0	1			81
25	11.4	0	0			80
30	16.4	0	0			80
32	20.0	0	0	0.99(a)	0-1	80
37	25.9	0	1	1.09	2-3	80
42	28.9	0	2		3-4	80
47	31.9	0	4		7-8	80
48	40.0	0	8	12.48(b)	11-12	80

(a) AC dust visible on test filter.

(b) Weight greater than predicted by appearance of test filter.



Schedule:	Minutes	Water, gpm	Solids, g/min
	0-32	0.002	5.72
	32-47	0.2	---
	47-48	0.2	5.72

TABLE 101. SINGLE-ELEMENT LOOP TEST NO. 147 Date: 20 Oct 67

Loop no.	3 (Al/SS)	Housing:	8" I.D. aluminum
		Element:	Filters Inc I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Coarse AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued for 15 min, then 5.72 g/min to end of test. *

Test fuel JP-5 batch no. 19 , fresh
Date blended with additives: 19 Oct 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 20 lb/Mbbl, Lubrizol 541 , Lot 24794

Test duration, min	42	Calculated dirt loading, g	183
Fuel throughput, gal	852	Actual element weight gain, g	186
Average rate, gpm	20.3		

Time	0 min	End test
Meter reading, gal	781	1633
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	46
IFT, distilled water, dyn/cm	26.1

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.6
pH	7.5
ST, dyn/cm	71.3

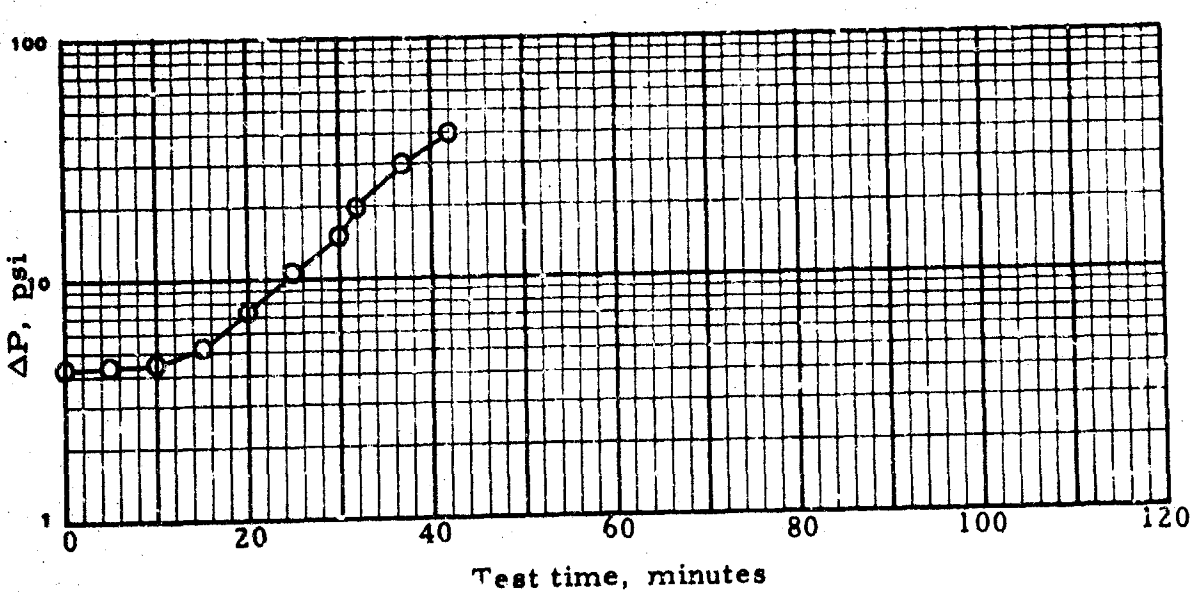
* In this test, the pressure drop reached 40 psi before the end of the 15-minute no-solids period; therefore, the second scheduled solid injection was not actually performed.

TABLE 101. SINGLE-ELEMENT LOOP TEST NO.147 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.2	0	0			80
5	4.3	0	0	0.27(a)	0	80
10	4.6	0	2			80
15	5.1	0	2			80
20	7.2	0	1			80
25	10.6	0	0			80
30	16.2	0	0			80
32	20.0	0	0(b)	1.69(a)	0	80
37	30.0	0	52	3.01(a)	20+	80
42	40.0	0	100+	1.56(a)	20+++	80

(a) Test filters were 0.45 μ instead of standard 0.8μ. AC dust was visible on all test filters.

(b) Effluent Totamitor reading started to increase at 33 min and continued to climb for remainder of test, reading 100+ at 42 min.



Schedule:	Minutes	Water, gpm	Solids, g/min
	0-32	0.002	5.72
	32-42	0.2	---

TABLE 102. LOOP TEST NO. 148 — Date: 23 October 1967

Al/SS loop with 8" I.D. aluminum housing, military-standard double-wall canister, and military-standard element (Filters Inc. I-4208, Lot 440).

Procedure 10: Modified MIL-F-8901A inhibited-fuel test with fuel flow 20 gpm and inlet pressure 70 psig. Filtered tap water injected at 0.2 gpm throughout test, coarse AC dust at 5.72 g/min after 60 min.

Test fuel uninhibited JP-5 Batch 19 plus additives as shown.
(X) Fresh-fuel blend OR ( ) Fuel from previous test
Fuel system icing inhibitor, Dow, Lot 03187126 — 0.15 vol. %
Corrosion inhibitor, Lubrizol 541 Lot 24794 — 20 lb/Mbbl

Fuel inlet temperature, °F 80 — Fuel throughput, gal 1922
Test duration, min 96 — Avg. flow rate, gpm 20.0

Actual element weight gain, g 220
Calculated dirt loading, g 206

		Pre-test	30 min	95 min
Influent fuel	Solids, mg/liter	0.21	0.19	0.14
	WSIM, dist. water	40		
	WSIM, inj. water	36		39
	IFT, dist. water, dyn/cm	27.1		31.1
	IFT, inj. water, dyn/cm	17.1		17.2
	FSII content, vol. %	0.12		0.02
Injection water	Solids, mg/liter		0.2	
	pH		7.7	7.6
	ST, dyn/cm		72.0	71.4
Coalesced water	pH		7.6	7.8
	ST, dyn/cm		26.9	50.7
	FSII content, vol. %		Too cloudy to run	

Time, min:	Pre-test	30	60	95	130	160	End
Screen ΔP, psi	0	0	0	0			0
Cleanup ΔP, psi	0	1	0	1			1
Throughput, gal	303	906	1505	2200			2225

TABLE 102. LOOP TEST NO. 148 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading
0	3.4			0
10	4.9			2
20	5.6			3
30	6.0	0.18	4-6	6
40	8.0			8
44			9-11	
50	8.9			10
53			15-17	15
57			20	20
60	11.0			23
70	14.0		18-20	35
80	19.0			65
82	20.0	0.17[a]	20++	75
87				100
90	28.0			100+
95	37.0			100+
96	40.0	0.46[a]	20+++	100+

a. Entire sample not filtered, because membrane filter plugged. True solids value probably higher than indicated.

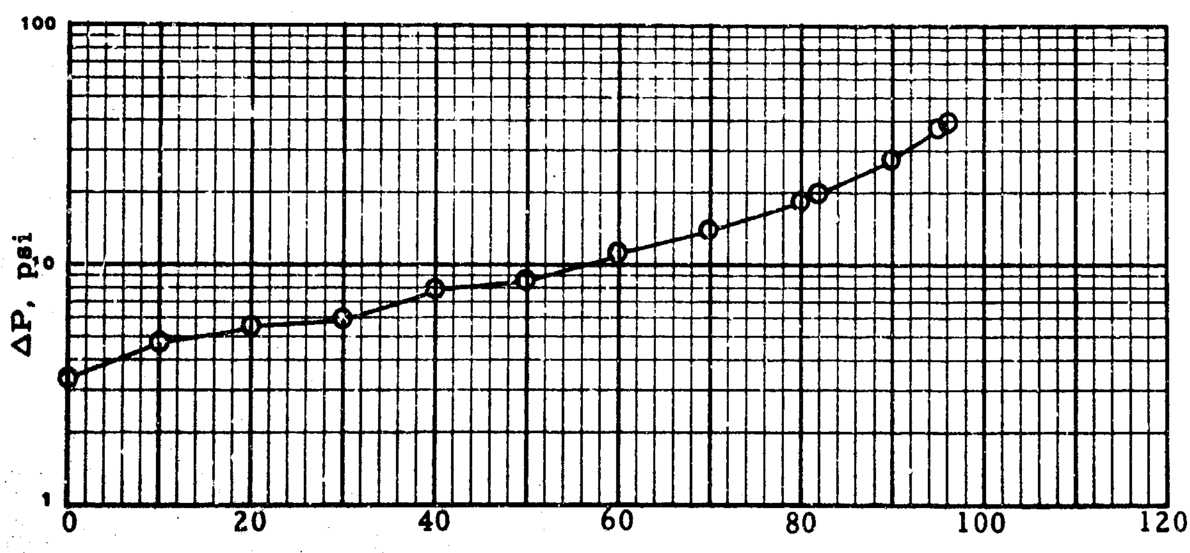


TABLE 103. SINGLE-ELEMENT LOOP TEST NO. 149 Date: 24 Oct 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	FineAC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, 0.2 gpm from 20 psi to the end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, discontinued 15 min, then 5.72 g/min to end of test*

Test fuel JP-5 batch no. 19 , fresh
Date blended with additives: 23 Oct 1967
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 20 lb/Mbbl, Lubrizol 541 , Lot 24794

Test duration, min	26	Calculated dirt loading, g	137
Fuel throughput, gal	506	Actual element weight gain, g	136
Average rate, gpm	19.5		

Time	0 min	End test
Meter reading, gal	298	804
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	41
IFT, distilled water, dyn/cm	26.2

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.5
ST, dyn/cm	7.18

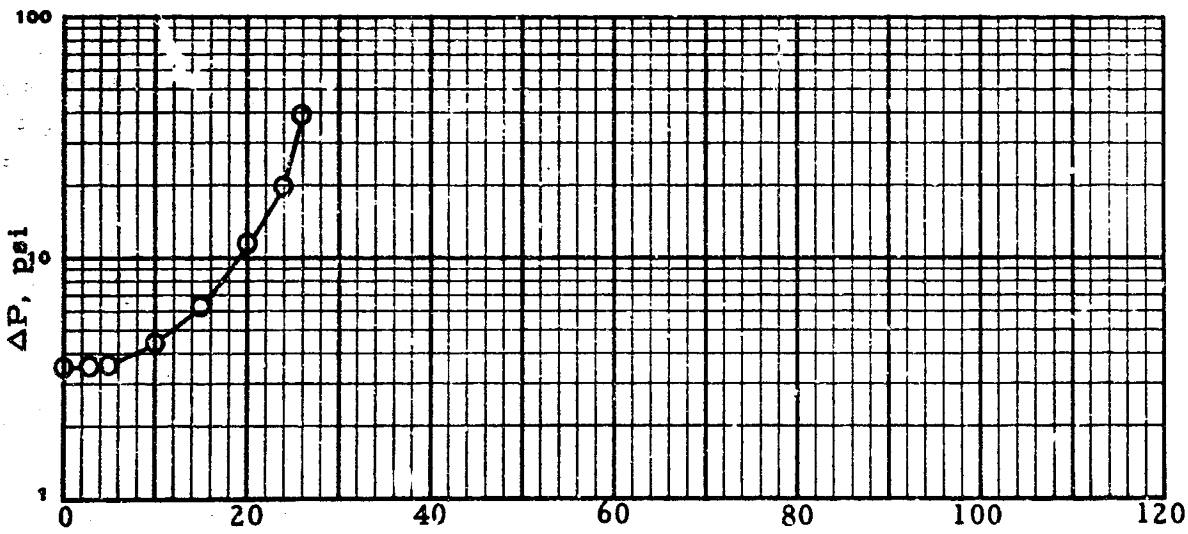
* In this test, the pressure drop reached 40 psi before the end of the 15-minute no-solids period; therefore, the second scheduled solid injection was not actually performed.

TABLE 103. SINGLE-ELEMENT LOOP TEST NO. 149 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.5	0	0			80
3	3.6	0	4		0	80
5	3.6	0	6	1.98(a)	0	80
10	4.4	0	5	0.71(b)		80
15	6.1	0	9			80
20	11.5	0	7			80
24	20.0	0	9	13.53(a)	6-7	80
26	40.0	0	100+	6.91(a)	20+	80

(a) AC dust visible on test filter.

(b) Line sample through matched-weight filters.



Schedule:

Minutes	Water, gpm	Solids, g/min
0-24	0.002	5.72
24-26	0.2	---

TABLE 104. SINGLE-ELEMENT LOOP TEST NO. 150 Date: 25 Oct 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440
		Canister:	DoD Type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, 0.2 gpm from 20 psi to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test*.

Test fuel JP-5 batch no. 19 , fresh
Date blended with additives: 24 Oct 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, AFA-1 , Lot 37

Test duration, min	43	Calculated dirt loading, g	160
Fuel throughput, gal	850	Actual element weight gain, g	149
Average rate, gpm	19.8		

Time	0 min	End test
Meter reading, gal	300	1150
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	83
IFT, distilled water, dyn/cm	23.2

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.74
pH	7.3
ST, dyn/cm	72.2

* Final solids-injection period less than 5 sec.

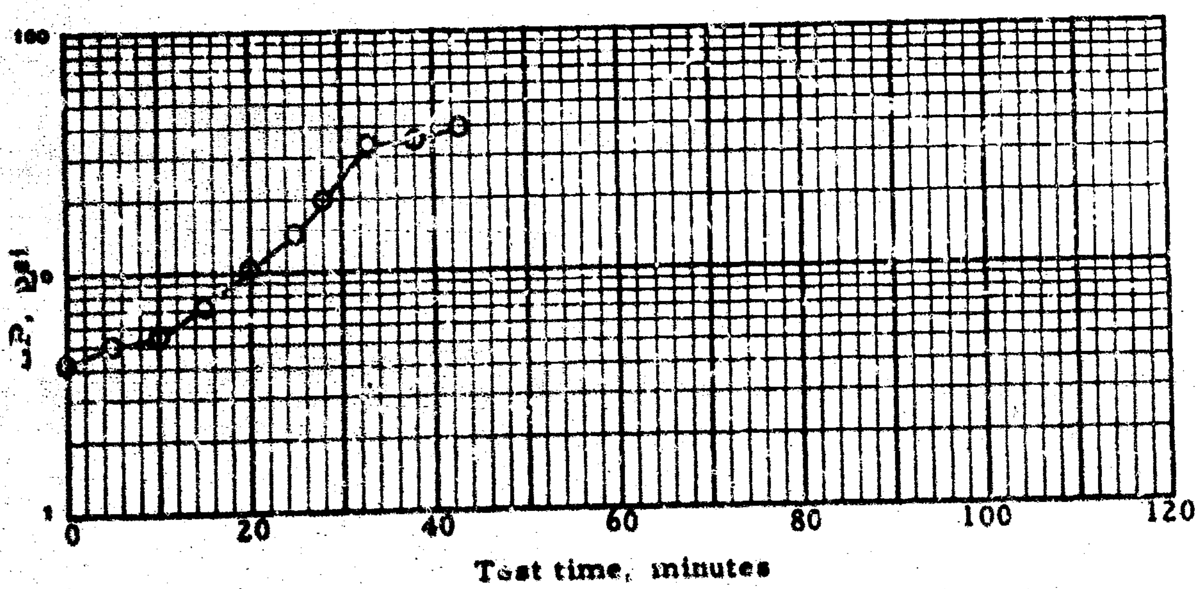
TABLE 104. SINGLE-ELEMENT LOOP TEST NO. 150 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.2	0	0			80
5	5.0	0	6	2.35(a)	0	80
10	5.6	0	6			80
15	7.2	0	6			80
20	10.1	0	5			80
25	15.6	0	3			80
28	20.0	0	2	3.58(a)	0	80
33	34.0	0	10	0.16(b)	7-9	80
38	35.5	0	28		12-14	80
43	40.0	0	28	0.19(c)	18-20	80

(a) AC dust visible on test filter.

(b) Sample clear when drawn, cloudy at time of analysis.

(c) Sample cloudy when drawn.



Schedule:	Minutes	Water, gpm	Solids, g/min
	0-28	0.002	5.72
	28-43	0.2	---
	43 (+5 sec)	0.2	5.72

TABLE 105. SINGLE-ELEMENT LOOP TEST NO. 151 Date: 30 Oct 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 30 Oct 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1 , Lot 37

Test duration, min	59	Calculated dirt loading, g	252
Fuel throughput, gal	1180	Actual element weight gain, g	239*
Average rate, gpm	19.9		

Time	0 min	End test
Meter reading, gal	300	1480
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	65
IFT, distilled water, dyn/cm	23.6

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.5
ST, dyn/cm	71.9

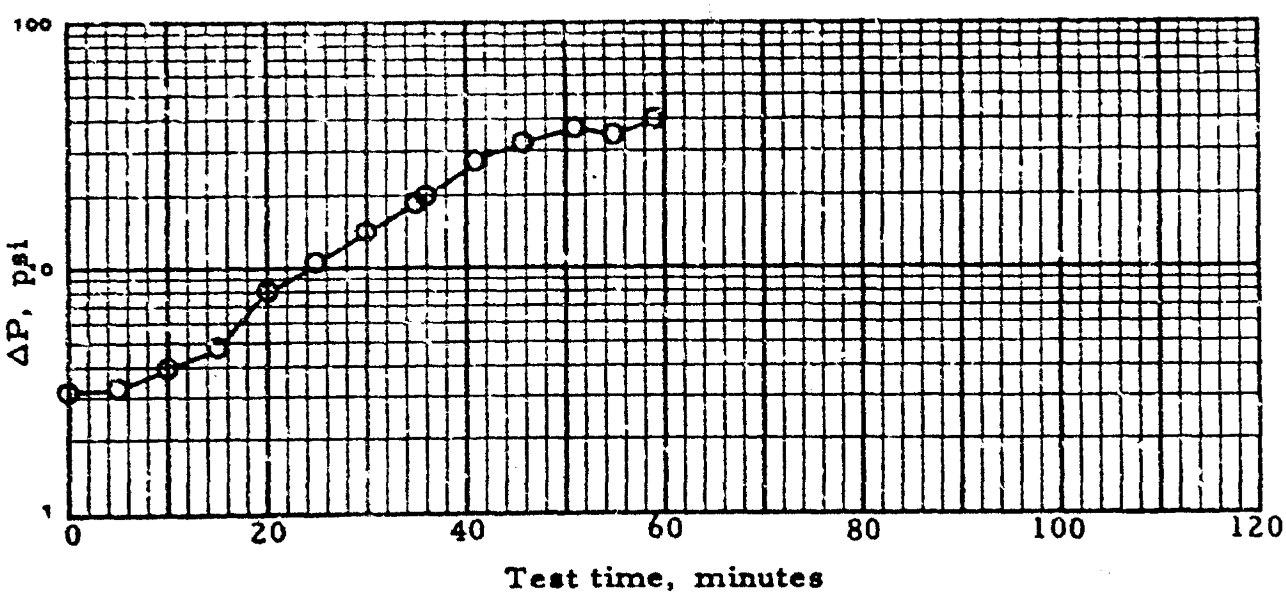
---

* Loss of test dust during element drying.

TABLE 105. SINGLE-ELEMENT LOOP TEST NO. 151 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.1	0	0			80
5	3.3	0	10	3.96 (a)	0	80
10	4.0	0	10			80
15	4.9	0	10			80
20	8.0	0	10			80
25	10.5	0	7			80
30	14.9	0	5			80
35	19.0	1	3			80
36	20.0	1	3	0.71 (a)	0	80
41	28.0	1	3	3.31 (a)	2-3	80
46	31.5	1	2		2-3	80
51	38.0	1	3		2-3	80
55	35.8	1	4			80
59	40.0	1	9	0.30	3-4	80

(a) AC Dust present on filter membrane.



Schedule:	Minutes	Water, gpm	Solids, g/min
	0-36	0.002	5.72
	36-51	0.2	----
	51-59	0.2	5.72

TABLE 106. SINGLE-ELEMENT LOOP TEST NO. 152 Date: 31 Oct 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 410-A
		Canister:	DoD type 1

Procedure no.	13-N	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm starting at 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 2.86 g/min from 0 min to 20 psi, then discontinued 15 min, then 2.86 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 30 Oct 67
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1 , Lot 37

Test duration, min	78	Calculated dirt loading, g	183
Fuel throughput, gal	1550	Actual element weight gain, g	162*
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	315	1865
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	48
IFT, distilled water, dyn/cm	23.4

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.6
ST, dyn/cm	72.4

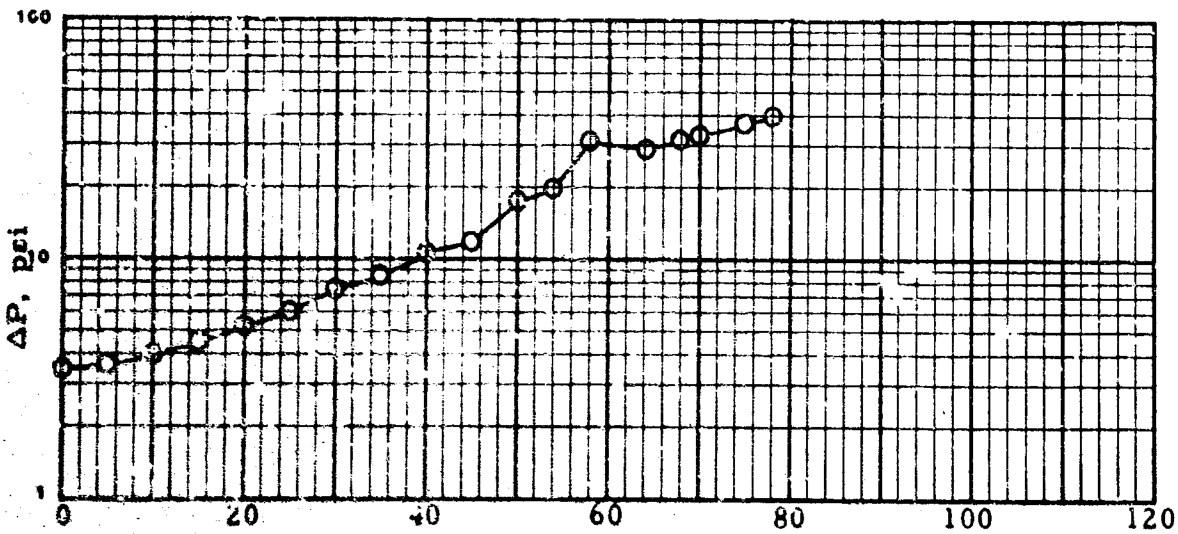
* Loss of test dust during element drying.

TABLE 106. SINGLE-ELEMENT LOOP TEST NO. 152 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.5	0	0			79
5	3.6	0	6	2.53 (a)	0	80
10	4.0	0	7			80
15	4.5	0	7			80
20	5.1	0	3			80
25	6.0	0	6			80
30	7.6	0	3			80
35	8.5	0	2			80
40	10.5	0	3			80
45	12.5	0	3			80
50	17.0	0	3			80
54	20.0	0	3 (b)	3.39 (a)	2-3	80
58	30.5	0	15	0.28 (a)	12-15	80
64	29.5	0	30		17-18	80
68	31.6	0	29		19-20	80
70	32.5	0	37			80
75	37.5	0	53			80
78	40.0	0	68	0.07	20+	80

(a) AC Dust present on filter membrane.

(b) Effluent Totamitor climbed to a peak reading of 26, then decreased to a reading of 8 for a period of 1 min., then began climbing again.



Test time, minutes

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-54	0.002	2.86
	54-68	0.2	----
	68-78	0.2	2.86

TABLE 107. SINGLE-ELEMENT LOOP TEST NO. 153 Date: 1 Nov 67

Loop no. 3 (Al/SS)

Housing: 8" I.D. aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-N
Water: Filtered tap water
Solids: Fine AC dust

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test

Solids injection schedule: 2.86 g/min from 0 min to 20 psi, then discontinued for 15 min, then 2.86 g/min to end of test.

Test fuel JP-5 batch no. 20, fresh
Date blended with additives: 31 Oct 67
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1, Lot 37

Test duration, min 98
Fuel throughput, gal 1963
Average rate, gpm 20.0

Calculated dirt loading, g 234
Actual element weight gain, g 225

Time	0 min	End test
Meter reading, gal	293	2256
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	68
IFT, distilled water, dyn/cm	24.2

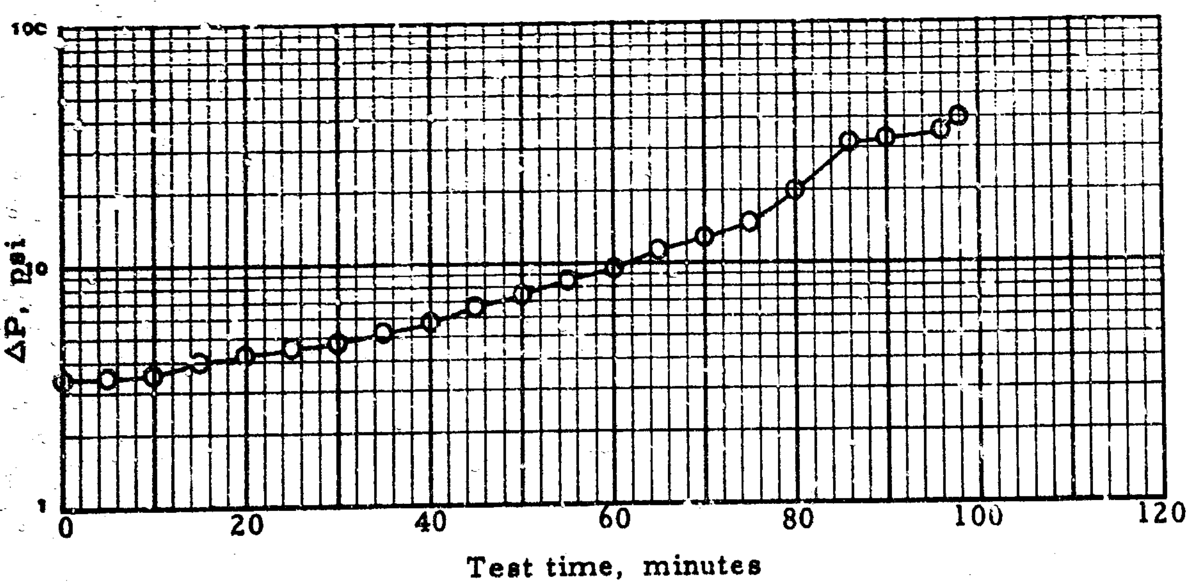
Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.6
ST, dyn/cm	72.8

TABLE 107. SINGLE-ELEMENT LOOP TEST NO. 153 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.4	0	0			81
5	3.5	0	2	0.95	0	80
10	3.6	0	2			80
15	4.0	0	1			80
20	4.3	0	2			80
25	4.5	0	2			80
30	4.8	0	2			80
35	5.1	0	2			80
40	5.9	0	2			80
45	6.7	0	2			80
50	7.4	0	2			80
55	8.5	0	2			80
60	9.7	0	2			80
65	11.4	0	2			80
70	13.6	0	2			80
75	16.4	0	2			80
80	20.0	0	2 (b)	12.91 (a)	3-4	80
86	30.1	0	5	0.94	10-12	80
90	32.7	0	6		10-12	80
96	36.0	0	8		8-10	80
98	40.0	0	10	0.73	10-12	80

(a) AC Dust present on filter membrane.
(b) Effluent Totamitor reading of 52, 20 sec after reaching 20 psi.



Schedule:	Minutes	Water, gpm	Solids, g/min
	0-80	0.002	2.86
	80-96	0.2	----
	96-98	0.2	2.86

TABLE 108. SINGLE-ELEMENT LOOP TEST NO. 154 Date: 3 Nov 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh

Date blended with additives: 2 Nov 67

Anti-icing additive 0.15 vol.%, Dow, Lot 03187126

Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1 , Lot 37

Test duration, min	39	Calculated dirt loading, g	200
Fuel throughput, gal	785	Actual element weight gain, g	186
Average rate, gpm	20.1		

Time	0 min	End test
Meter reading, gal	338	1123
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	49
IFT, distilled water, dyn/cm	24.0

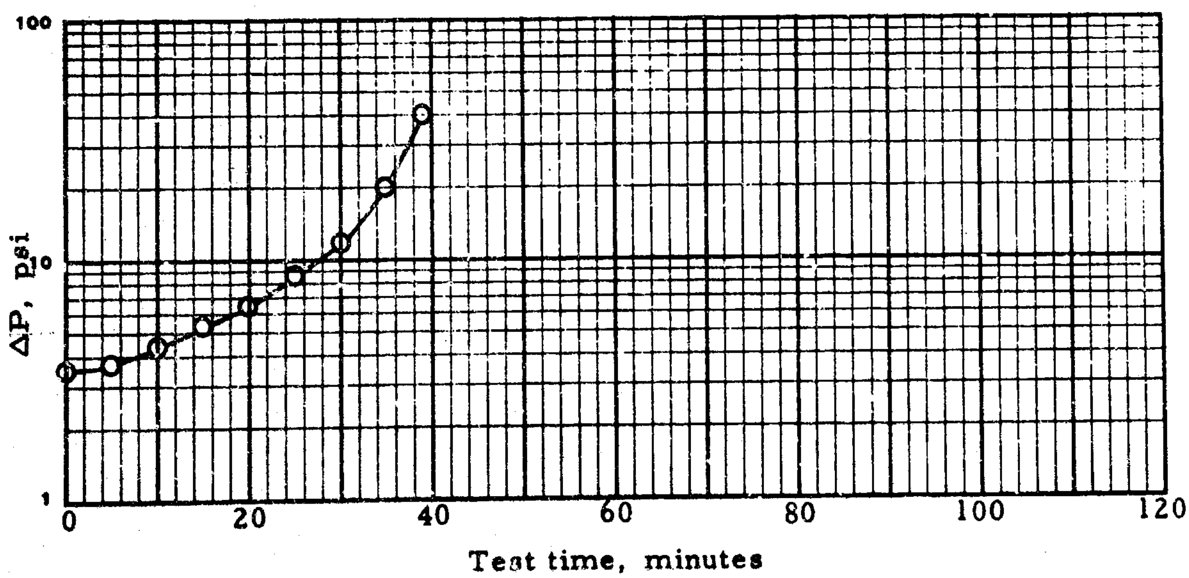
Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.8
ST, dyn/cm	71.9

TABLE 108. SINGLE-ELEMENT LOOP TEST NO. 154 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.5	0	0			80
5	3.8	0	3	1.29 (a)	1-2	80
10	4.4	0	4			80
15	5.2	0	5			80
20	6.6	1	5			80
25	8.8	1	4			80
30	12.0	1	7			80
35	20.0	1	10 (b)	13.89 (c)	19-20	80
39	40.0	1	100 +	0.86 (d)	20+++	80

(a) Clear when pulled.
(b) Effluent Totamitor read 100+, 30 sec after reaching 20 psi.
(c) AC Dust present on filter membrane.
(d) Qt sample was used.



Schedule:

Minutes	Water, gpm	Solids, g/min
0-35	0.002	5.72
35-39	0.2	----

TABLE 109. SINGLE-ELEMENT LOOP TEST NO. 155 Date: 10 Nov 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 9 Nov 67
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1 , Lot 37

Test duration, min	42	Calculated dirt loading, g	223
Fuel throughput, gal	845	Actual element weight gain, g	212
Average rate, gpm	19.8		

Time	0 min	End test
Meter reading, gal	296	1141
Screen ΔP, psi	1	1
Cleanup ΔP, psi	1	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	60
IFT, distilled water, dyn/cm	22.5

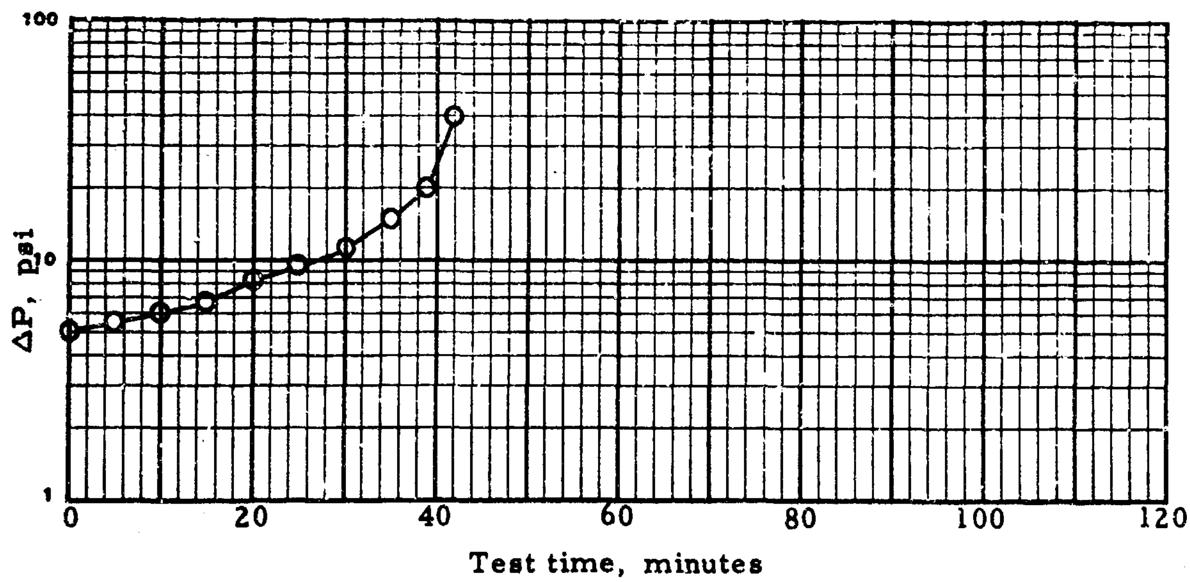
Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.4
ST, dyn/cm	71.9

TABLE 109. SINGLE-ELEMENT LOOP TEST NO. 155 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	5.0	0	0			80
5	5.6	0	0	neg.	1-2	80
10	6.0	0	0			80
15	6.9	0	0			80
20	8.1	0	0			80
25	9.6	0	0			80
30	11.7	0	0			80
35	15.0	0	0			80
39	20.0	0	1 (a)	5.42 (b)	18-19	80
42	40.0	0	100	1.09 (c)	20+++	80

(a) Effluent Totamitor read 100, 15 sec after reaching 20 psi.
(b) AC Dust present on filter membrane.
(c) Qt sample was used, AC Dust present on filter membrane.



Schedule:

Minutes	Water, gpm	Solids, g/min
0-39	0.002	5.72
39-42	0.2	----

TABLE 110. SINGLE-ELEMENT LOOP TEST NO. 156 Date: 10 Nov 67

Loop no.	3 (Al/SS)	Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-N	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 2.86 g/min from 0 min to 20 psi, then discontinued 15 min, then 2.86 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 10 Nov 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, DuPont AFA-1 , Lot 37

Test duration, min	93	Calculated dirt loading, g	260
Fuel throughput, gal	1863	Actual element weight gain, g	265
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	309	2172
Screen ΔP, psi	0	0
Cleanup ΔP, psi	2	2

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	40
IFT, distilled water, dyn/cm	23.3

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.5
ST, dyn/cm	72.6

TABLE 110. SINGLE-ELEMENT LOOP TEST NO. 156 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.9	0	0			80
5	5.1	0	0	neg.	1-2	80
10	5.3	0	0			80
15	5.4	0	0			80
20	5.6	0	0			80
25	6.1	0	0			80
30	6.5	0	0			80
35	7.0	0	0			80
40	7.4	0	0			80
45	7.5	0	0			80
50	8.0	0	0			80
55	8.8	0	0			80
60	9.5	0	0			80
65	10.4	0	0			80
70	11.4	0	0			80
75	12.0	0	0			80
80	13.6	0	0			80
85	15.6	0	0			80
90	19.0	0	0			80
91	20.0	0	0	neg. (a)	17-18	80
93	40.0	0	9	0.73 (a)	20+	80

(a) AC Dust present on filter membrane. Results considered suspect because of disagreement with visual evidence and problems with calibration of balance.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-91	0.002	2.86
91-93	0.2	----

TABLE 110. LOOP TEST NO. 156 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

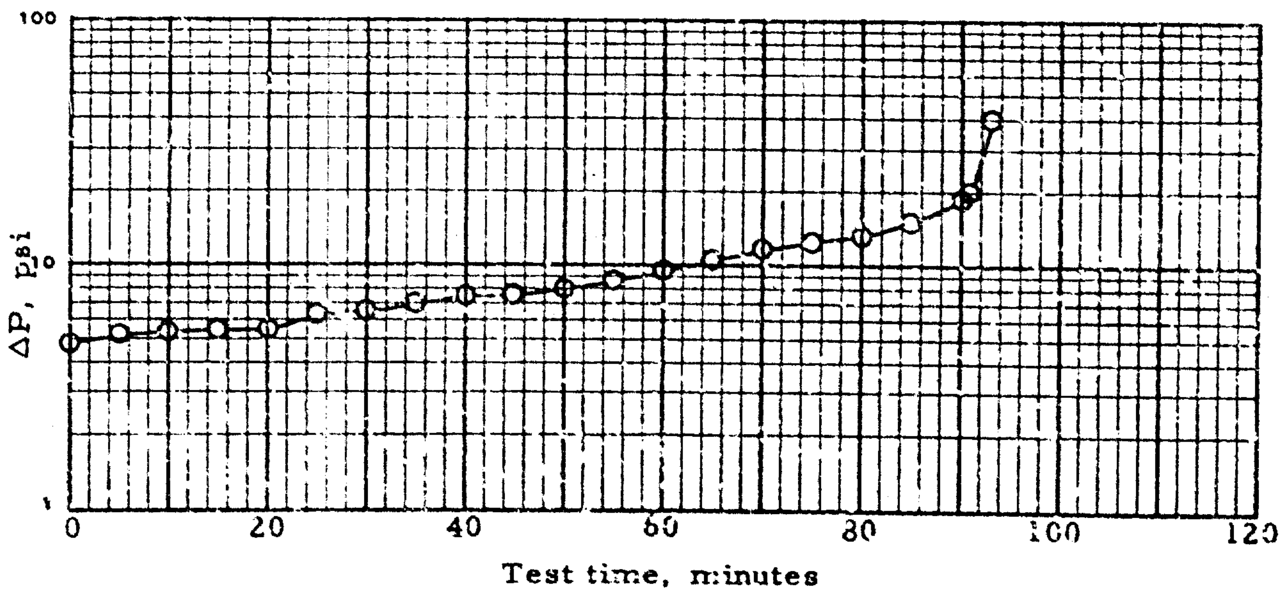


TABLE 111. SINGLE-ELEMENT LOOP TEST NO. 157 Date: 13 Nov 67

Loop no.	3 (Al/SS)	Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 13 Nov 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, DuPont AFA-1 , Lot 37

Test duration, min	32	Calculated dirt loading, g	166
Fuel throughput, gal	636	Actual element weight gain, g	148
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	300	936
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	56
IFT, distilled water, dyn/cm	33.0

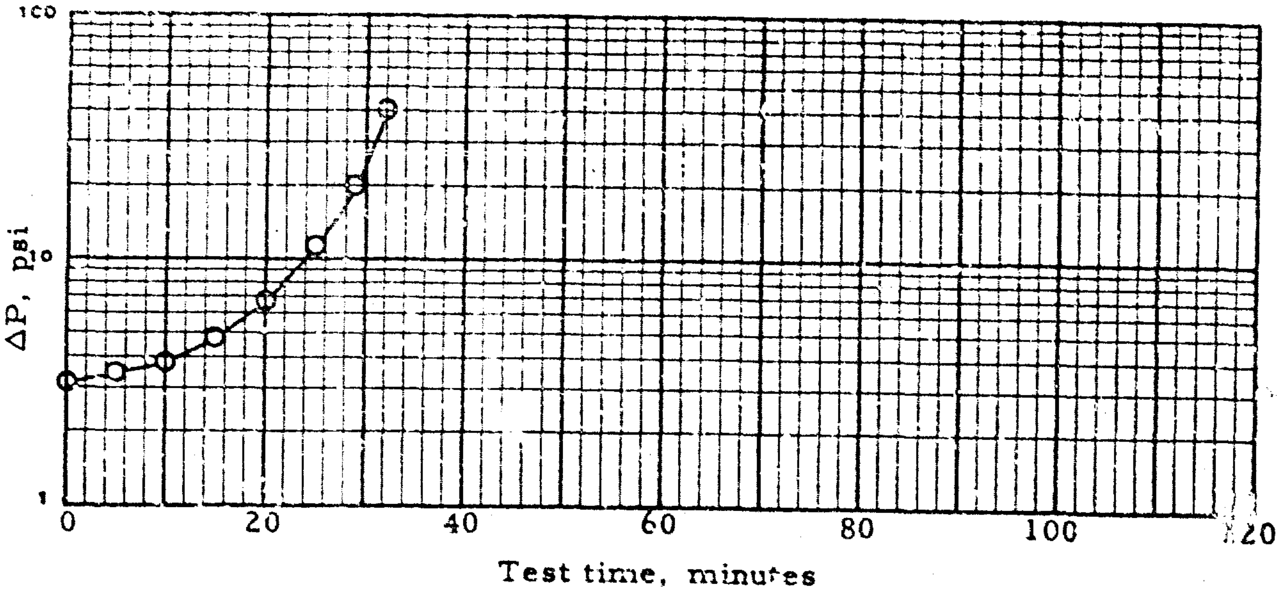
Analyses on injection water:

Time	Post-test
Solids, mg/liter	Neg.
pH	7.4
ST, dyn/cm	72.8

TABLE 111. SINGLE-ELEMENT LOOP TEST NO. 157 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.1	0	0 (a)			80
5	3.4	0	14	6.04 (b)	0	80
10	3.9	0	16			80
15	4.9	0	15			80
20	6.9	0	16			80
25	11.5	0	18			80
29	20.0	0	19	23.18 (c)	2-3	80
32	40.0	0	35	1.78 (d)	20+	80

(a) Effluent Totamitor began to rise after 30 sec of injection of AC Dust.
(b) Heavy AC Dust present on filter membrane.
(c) Qt sample, heavy AC Dust present on filter membrane.
(d) Qt sample, cloudy.



Schedule:	Minutes	Water, gpm	Solids, g/min
	0-29	0.002	5.72
	29-32	0.2	----

TABLE 112. SINGLE-ELEMENT LOOP TEST NO. 158 Date: 14 Nov 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-N	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 2.86 g/min from 0 min to 20 psi, then discontinued 15 min, then 2.86 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 13 Nov 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, DuPont AFA-1 , Lot 37

Test duration, min	65	Calculated dirt loading, g	172
Fuel throughput, gal	1300	Actual element weight gain, g	157
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	299	1599
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	66
IFT, distilled water, dyn/cm	33.9

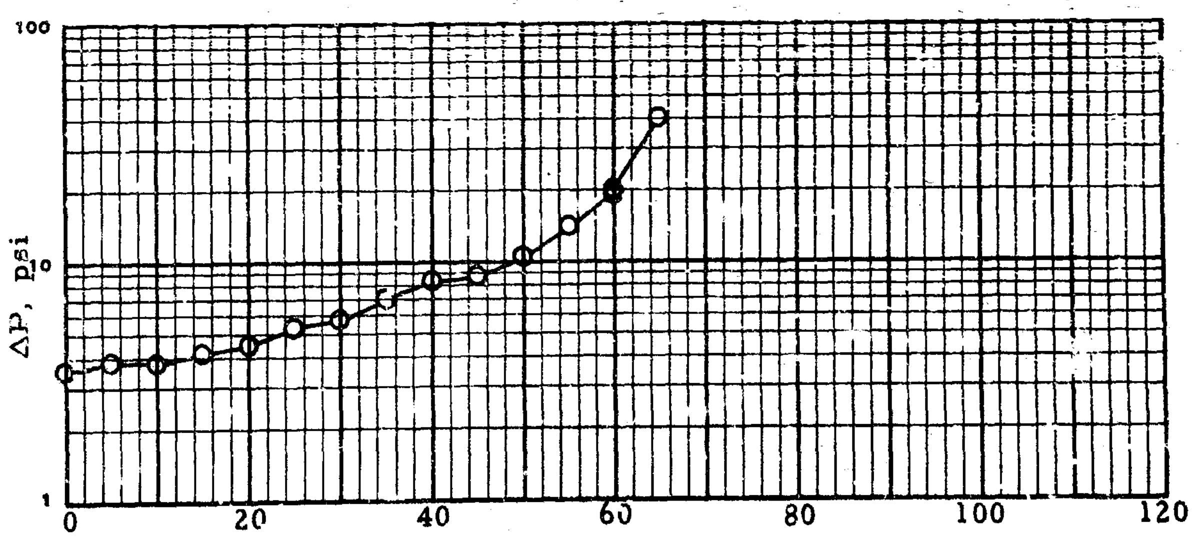
Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.3
pH	7.6
ST, dyn/cm	72.4

TABLE 112. SINGLE-ELEMENT LOOP TEST NO. 158 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.5	0	0 (a)			80
5	3.9	0	5	1.91 (b)	0	80
10	3.9	0	5			80
15	4.1	0	5			80
20	4.6	0	4			80
25	5.2	0	2			80
30	5.9	0	3			80
35	7.0	0	4			80
40	8.1	0	4			80
45	8.9	0	4			80
50	10.4	0	6			80
55	14.6	0	5			80
60	19.9	0	3			80
60	20.0	0	3 (c)	10.63 (b)	3-4	80
65	40.0	0	100+	0.61 (d)	20+++	80

(a) Effluent Totamitor climbed to a peak reading of 5, 30 sec after injection.
(b) AC Dust present on filter membrane.
(c) Effluent Totamitor climbed sharply to a peak reading of 100+, 2 min 50 sec after reaching 20 psi.
(c) Qt sample taken.



Schedule:	Minutes	Water, gpm	Solids, g/min
	0-60	0.002	2.86
	60-65	0.2	----

TABLE 113. SINGLE-ELEMENT LOOP TEST NO. 159 Date: 17 Nov 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20, fresh
Date blended with additives: 16 Nov 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Monsanto Santolene "C", Lot NH-04006

Test duration, min	28	Calculated dirt loading, g	137
Fuel throughput, gal	560	Actual element weight gain, g	135
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	300	860
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

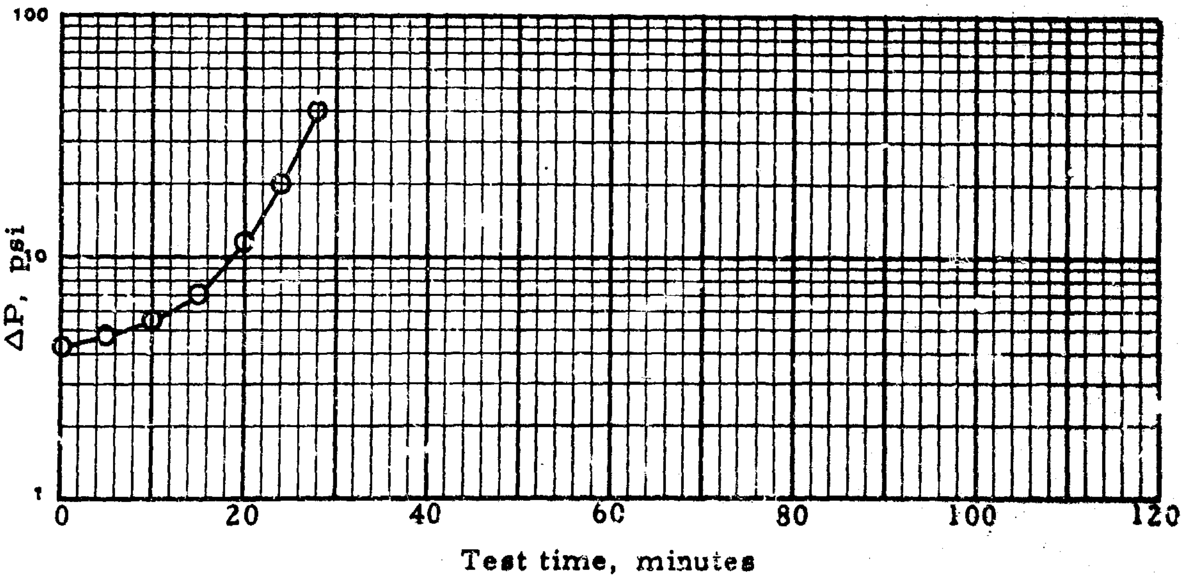
Time	Pre-test
WSIM, distilled water	69
IFT, distilled water, dyn/cm	36.0

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.8
ST, dyn/cm	72.6

TABLE 113. SINGLE-ELEMENT LOOP TEST NO. 159 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.2	0	0			80
5	4.8	0	0	0.11	0	80
10	5.5	0	0			80
15	7.0	0	0			80
20	11.5	0	0			80
24	20.0	0	18	0.26	8-10	80
28	40.0	0	20	0.13	18-20	80



Schedule:	Minutes	Water, gpm	Solids, g/min
	0-24	0.002	5.72
	24-28	0.2	----

TABLE 114. SINGLE-ELEMENT LOOP TEST NO. 160 Date: 20 Nov 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-N	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 2.86 g/min from 0 min to 20 psi, then discontinued 15 min, then 2.86 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 20 Nov 67
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Monsanto Santolene "C", Lot NH-04005

Test duration, min	114	Calculated dirt loading, g	28[illegible]
Fuel throughput, gal	2282	Actual element weight gain, g	278
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	494	2776
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	71
IFT, distilled water, dyn/cm	36.7

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.6
ST, dyn/cm	71.8

Pre-test ran an extra 10 min, due to the possibility of water being left in the element after inspection.

TABLE 114. SINGLE-ELEMENT LOOP TEST NO. 160 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.4	0	0			79
5	4.4	0	0	0.01	0	79
10	4.5	0	0			79
15	4.5	0	0			80
20	4.9	0	0			80
25	5.1	0	0			81
30	5.4	0	0			80
35	5.7	0	0			80
40	6.1	0	0			80
45	6.7	0	0			80
50	7.3	0	0			80
55	8.2	0	0			80
60	9.1	0	0			80
65	10.4	0	0			80
70	11.9	0	0			80
75	13.6	0	0			80
80	15.9	0	0			80
85	18.6	0	0			80
87	20.0	0	0 (a)	0.08	1-2	80
92	25.7	0	0	0.01	0	80
97	27.9	0	0		0	80
102	28.9	0	0		0	80
105	32.0	0	0			80
110	36.0	0	0 (b)			80
114	40.0	0	0	0.05	1-2	80

(a) Effluent Totamitor reached a peak of 3, 1 min after reaching 20 psi, then leveled off to zero.

(b) Effluent Totamitor read 3, 10 sec after reading was taken.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-87	0.002	2.86
98-102	0.2	----
102-114	0.2	2.86

TABLE 114. LOOP TEST NO. 160 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

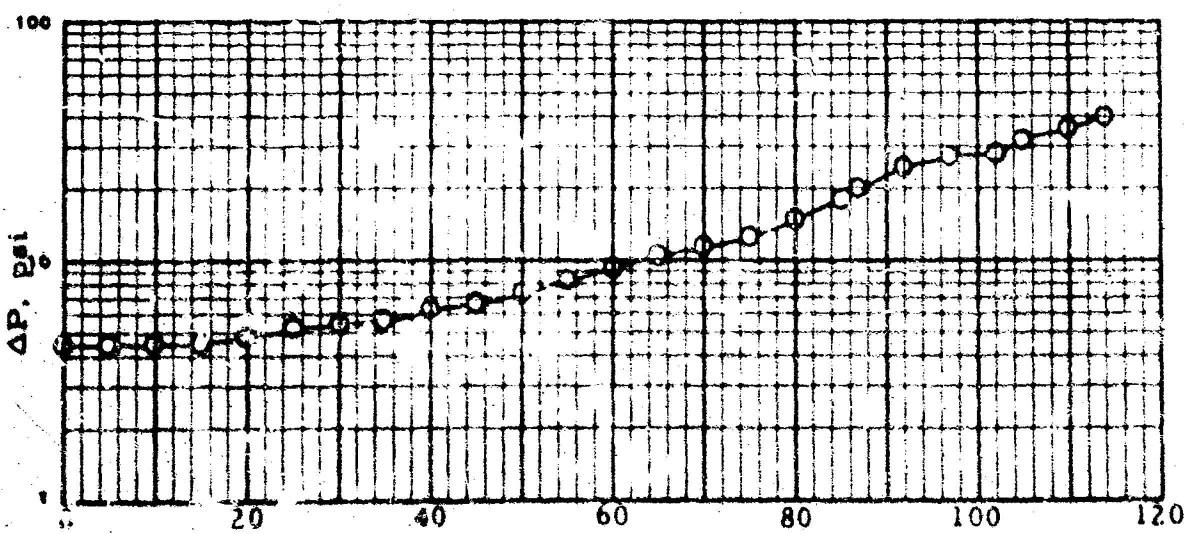


TABLE 115. SINGLE-ELEMENT LOOP TEST NO. 161 Date: 21 Nov 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80 *
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 20 Nov 67
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Monsanto Santolene "C", Lot NH-04006

Test duration, min	30	Calculated dirt loading, g	132
Fuel throughput, gal	587	Actual element weight gain, g	133
Average rate, gpm	19.6		

Time	0 min	End test
Meter reading, gal	341	928
Screen ΔP, psi	1	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	72
IFT, distilled water, dyn/cm	36.0

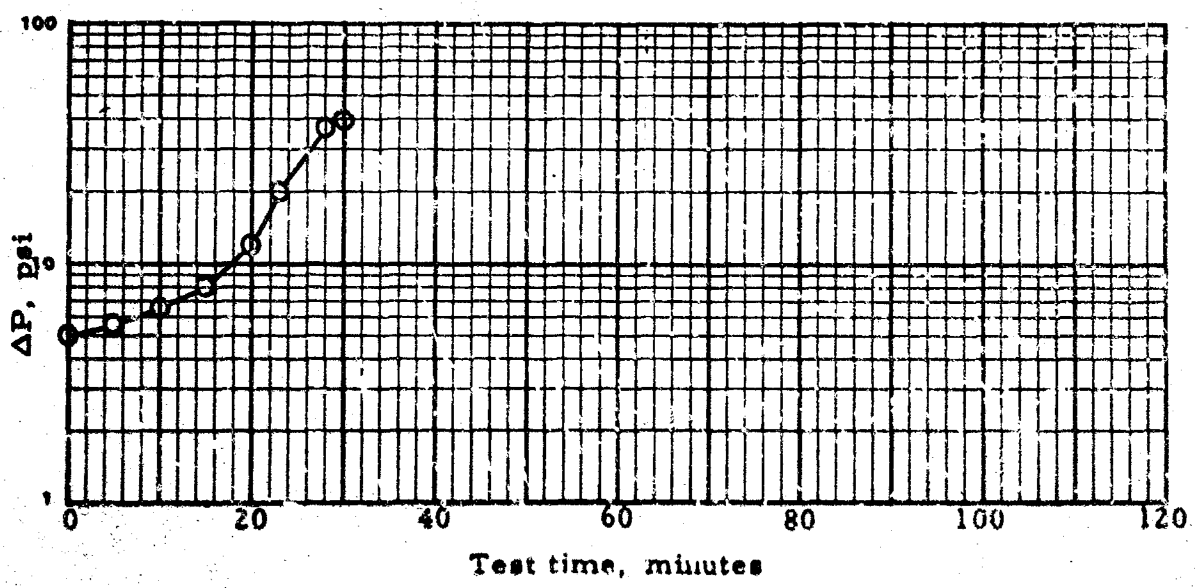
Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.8
ST, dyn/cm	72.5

* Temperature 75°F at start of test, 78-81°F after first 10 min.

TABLE 115. SINGLE-ELEMENT LOOP TEST NO. 161 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	5.0	0	0			75
5	5.5	0	0	neg.	2-3	77
10	6.5	0	0			78
15	8.0	0	0			80
20	12.0	0	0			81
23	20.0	0	0	0.02	0-1	78
28	37.0	0	1	0.01	4-5	80
30	40.0	0	4	neg.	8-9	81



Schedule

Minutes	Water, gpm	Solids, g/min
0-23	0.002	5.72
23-30	0.2	----

TABLE 116. SINGLE-ELEMENT LOOP TEST NO. 162 Date: 22 Nov 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4205 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20, fresh
Date blended with additives: 21 Nov 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Monsanto Santolene "C", Lot NH-04006

Test duration, min	47	Calculated dirt loading, g	263
Fuel throughput, gal	950	Actual element weight gain, g	262
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	300	1250
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	72
IFT, distilled water, dyn/cm	33.4

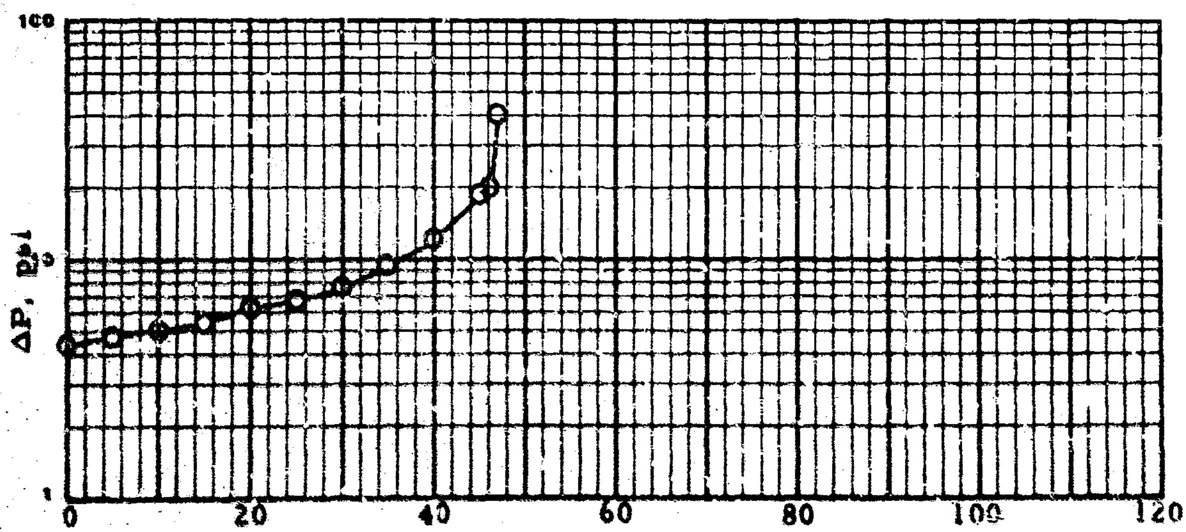
Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.[illegible]
ST, dyn/cm	72.0

TABLE 116. SINGLE-ELEMENT LOOP TEST NO. 162 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.3	0	1			80
5	4.7	0	0	0.01	0	80
10	5.0	0	0			80
15	5.4	0	0			80
20	6.1	0	0			80
25	6.8	0	0			80
30	7.7	0	0			80
35	9.4	0	0			80
40	12.1	0	0			80
45	19.0	0	0			80
46	20.0	0	0 (a)	0.13	20+	80
47	40.0	0	14	0.16	20+	80

(a) Effluent Totamitor climbed to 30, 30 sec after reaching 20 psi.



Schedule:	Minutes	Water, gpm	Solids, g/min
	0-46	0.002	5.72
	46-47	0.2	----

TABLE 117. SINGLE-ELEMENT LOOP TEST NO. 163 Date: 27 Nov 67

Loop no.	3 (Al/SS)	Housing:	8" I. D. aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-N	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 2.86 g/min from 0 min to 20 psi, then discontinued 15 min, then 2.86 g/min to end of test.

Test fuel JP-5 batch no. 20, fresh
Date blended with additives: 27 Nov 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Monsanto Santolene "C", Lot NH-04006

Test duration, min	102	Calculated dirt loading, g	280
Fuel throughput, gal	2033	Actual element weight gain, g	296
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	298	2331
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	60
IFT, distilled water, dyn/cm	36.5

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.6
ST, dyn/cm	72.7

TABLE 117. SINGLE-ELEMENT LOOP TEST NO. 163 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.3	0	0			80
5	4.3	0	0	0.01	1-2	80
10	4.5	0	0			80
15	4.5	0	0			80
20	4.7	0	0			80
25	4.8	0	0			80
30	5.0	0	0			80
35	5.2	0	0			80
40	5.4	0	0			80
45	5.7	0	0			80
50	6.1	0	0			80
55	6.5	0	0 (a)			80
60	7.2	0	0			80
65	7.8	0	0			80
70	8.5	0	0			80
75	9.5	0	0			80
80	10.6	0	0			80
85	12.0	0	0			80
90	14.4	0	0			80
95	17.6	0	0			80
98	20.0	0	0	0.09	20+	80
100	35.2	0	22			80
102	40.0	0	26 (b)	0.47 (c)	20+++	80

(a) Effluent Totamitor dropped below zero from this point.
(b) Effluent Totamitor peaked at a reading of 34, 101 min into test.
(c) Qt sample was used.

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-98	0.002	2.86
	98-102	0.2	----

TABLE 117. LOOP TEST NO. 163 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

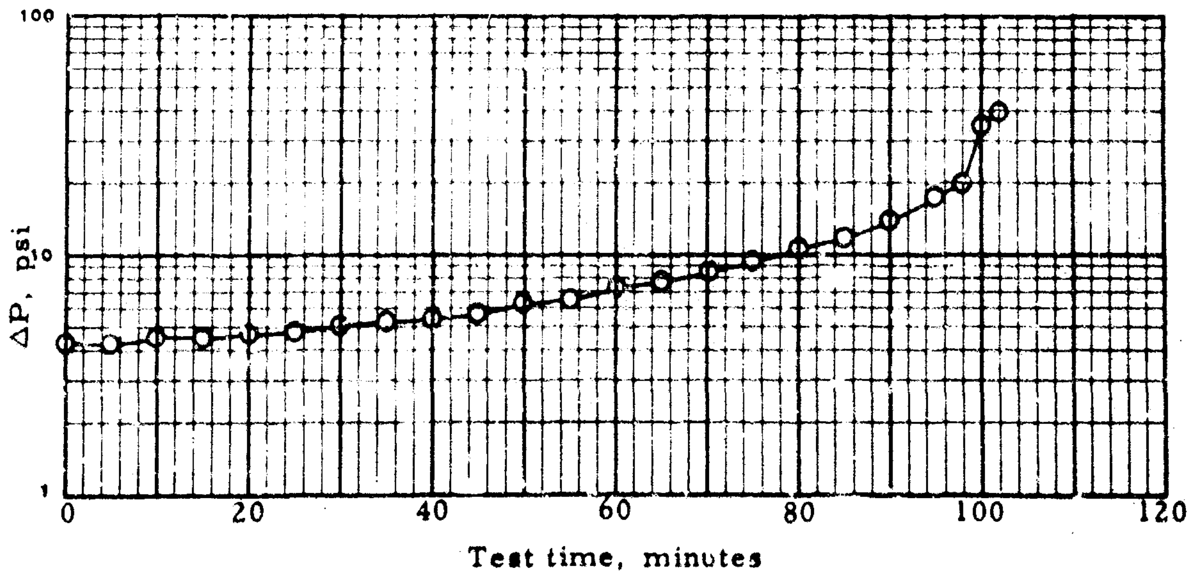


TABLE 118. SINGLE-ELEMENT LOOP TEST NO. 164 Date: 28 Nov 67

Loop no.	3 (Al/SS)	Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-N	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 2.86 g/min from 0 min to 20 psi, then discontinued 15 min, then 2.86 g/min to end of test.

Test fuel JP-5 batch no. 20, fresh
Date blended with additives: 27 Nov 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Monsanto Santolene "C", Lot NH-04006

Test duration, min	98	Calculated dirt loading, g	252
Fuel throughput, gal	1955	Actual element weight gain, g	259
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	600	2555
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	57
IFT, distilled water, dyn/cm	34.2

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.6
ST, dyn/cm	72.4

Pre-test extended 15 min, due to water in element from inspection.

TABLE 118. SINGLE-ELEMENT LOOP TEST NO. 164 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.3	0	0			80
5	4.4	0	0	neg.	1-2	80
10	4.6	0	0			80
15	4.8	0	0			80
20	5.1	0	0			80
25	5.4	0	0			80
30	5.8	0	0			80
35	6.2	0	0			80
40	6.6	0	0			80
45	7.3	0	0			80
50	8.0	0	0			80
55	8.7	0	1			80
60	9.5	0	1			80
65	10.4	0	1			80
70	11.6	0	1			80
75	13.5	0	1			80
80	15.1	0	1			80
85	17.3	0	1			80
88	20.0	0	1 (a)	0.08	8-9	80
90	29.2	0	2			80
94	33.5	0	3	0.02	10-12	80
95	36.1	0	3			80
98	40.0	0	5	0.06	10-12	80

(a) Effluent Totamitor peaked at 6, 30 sec after 20 psi.

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-88	0.002	2.86
	88-98	0.2	----

TABLE 118. LOOP TEST NO. 164 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

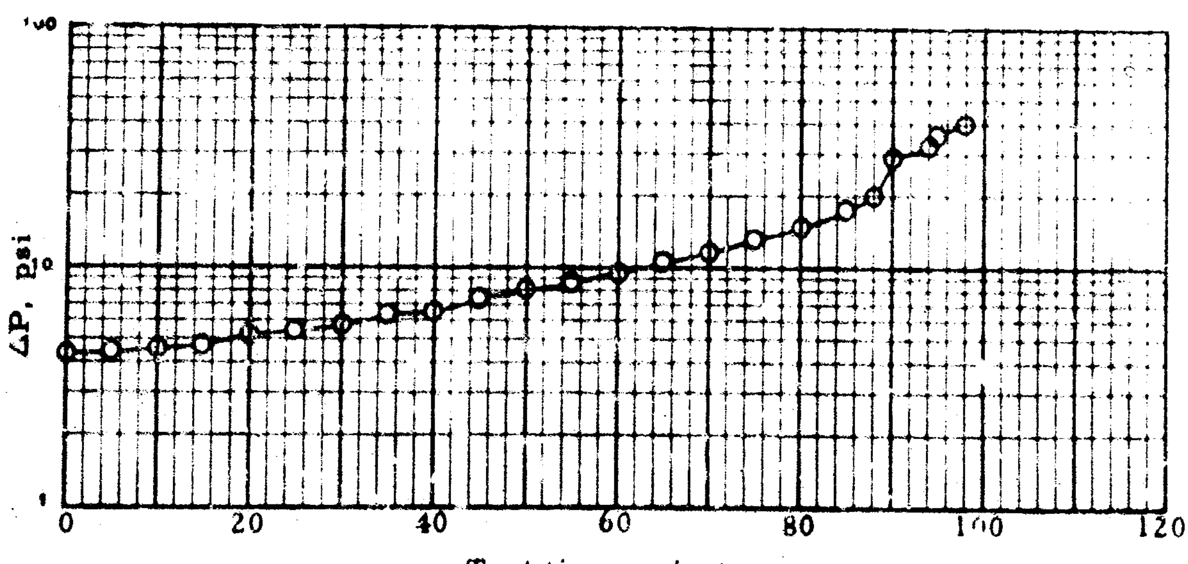


TABLE 119. SINGLE-ELEMENT LOOP TEST NO. 165 Date: 29 Nov 67

Loop no.	3 (A1/33)	Housing:	3" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440 A
		Canister:	DoD type 1

Procedure no.	13-N	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 2.86 g/min from 0 min to 20 psi, then discontinued 15 min, the 2.86 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 28 Nov 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Monsanto Santolene "C", Lot NH-04006

Test duration, min	106	Calculated dirt loading, g	260
Fuel throughput, gal	2130	Actual element weight gain, g	294
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	300	2430
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	65
IFT, distilled water, dyn/cm	40.6

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.7
ST, dyn/cm	71.6

TABLE 119. SINGLE-ELEMENT LOOP TEST NO. 165 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.8	0	0			80
5	4.9	0	0	neg.	1-2	80
10	5.0	0	0			80
15	5.1	0	0			80
20	5.6	0	0			80
25	5.9	0	0			80
30	6.2	0	0			80
35	6.6	0	0			80
40	7.3	0	0			80
45	8.4	0	0			80
50	9.1	0	0			80
55	10.4	0	0			80
60	11.6	0	0			80
65	13.6	0	0			80
70	16.2	0	0			80
75	18.8	0	0			80
77	20.0	0	0 (a)	0.30 (b)	19-20	80
82	23.2	0	44	neg. (c)	20+	80
37	27.5	0	55		20+	80
92	29.1	0	55		20+	80
95	32.0	0	55			80
100	34.5	0	75			80
105	38.3	0	92			80
106	40.0	0	84	(d)	20+++	80

(a) Effluent Totamitor began to show a reading 40 sec after reaching 20 psi.
(b) Sample cloudy, quart sample taken.
(c) Sample cloudy, quart sample taken.
(d) Sample lost.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-77	0.002	2.86
77-92	0.2	----
92-106	0.2	2.86

TABLE 119. LOOP TEST NO. 165 (Cont'd)

Time, min	ΔP, psi	Effluent Fuel Quality: Solids mg/liter	Free water, mg/liter	Totamitor Reading

See preceding page

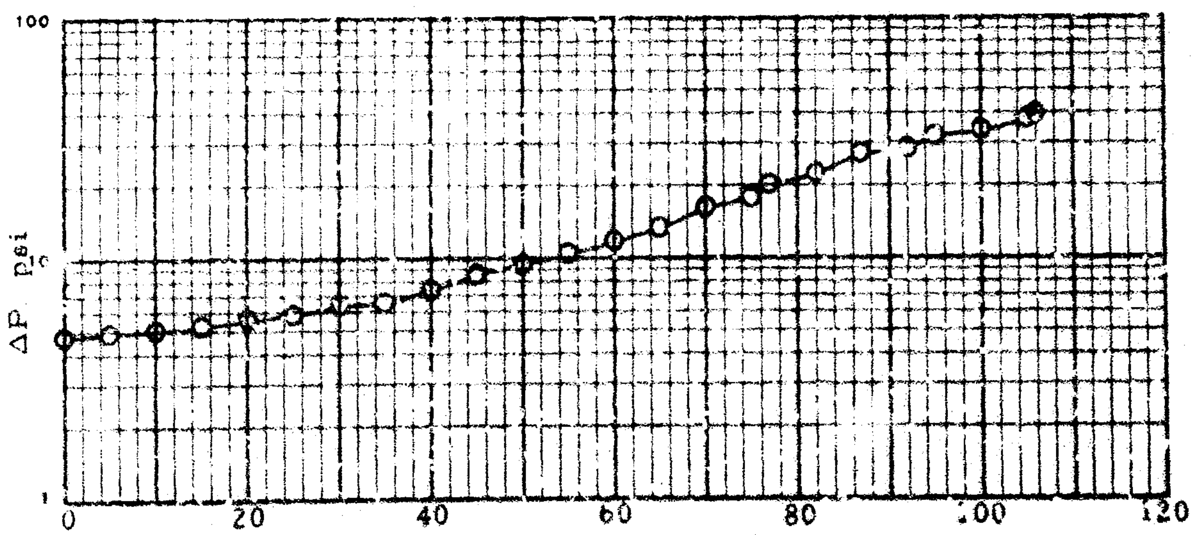


TABLE 120. SINGLE-ELEMENT LOOP TEST NO. 166 Date: 30 Nov 67

Loop no.	3 (Al/SS)	Housing:	8" I.D. aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-O	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	1:1 Fine & coarse AC dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 29 Nov 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Monsanto Santolene "C", Lot NH-04006

Test duration, min	44	Calculated dirt loading, g	166
Fuel throughput, gal	879	Actual element weight gain, g	192
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	296	1175
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	50
IFT, distilled water, dyn/cm	36.1

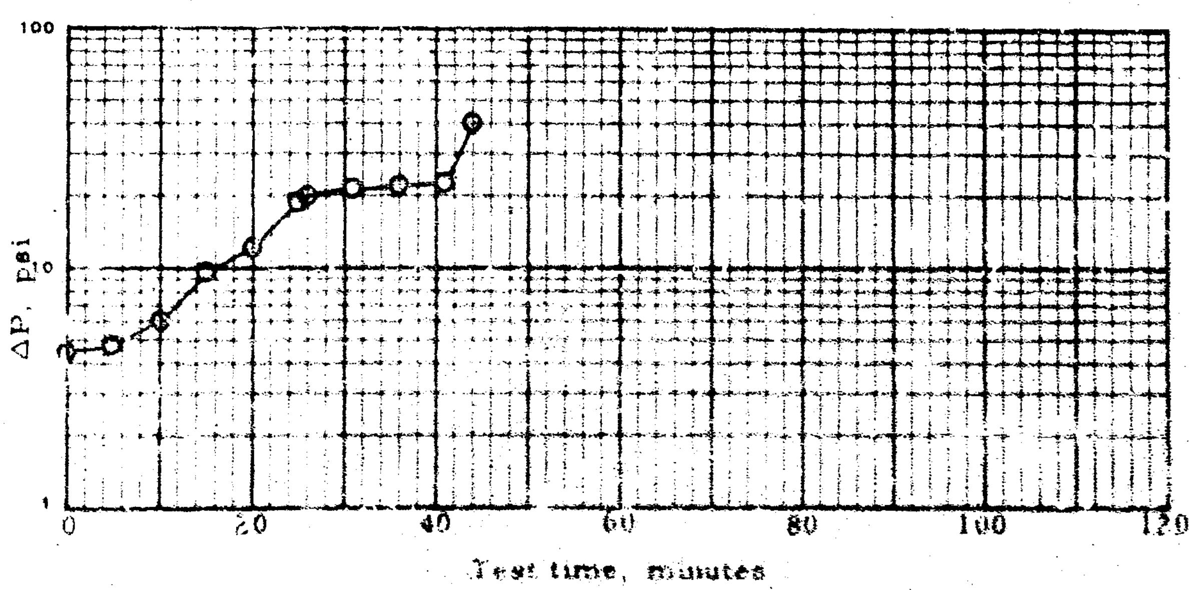
Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.7
ST, dyn/cm	73.0

TABLE 120. SINGLE-ELEMENT LOOP TEST NO. 166 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.5	0	0			81
5	4.9	0	0		0	80
10	6.0	0	0			80
15	9.6	0	0			80
20	13.8	0	0			80
25	19.0	0	0			80
26	20.0	0	0 (a)	0.03	1-2	80
31	21.4	0	0	neg.	1-2	80
36	21.8	0	0		1-2	80
41	22.4	0	0		1-2	80
44	40.0	0	1	0.03	5-7	80

(a) Effluent Totamitor increased to 1 after 1 min upon reaching 20 psi; then dropped to zero.



Schedule:

Minutes	Water, gpm	Solids, g/min
0-26	0.002	5.72
26-41	0.2	----
41-44	0.2	5.72

TABLE 121. SINGLE-ELEMENT LOOP TEST NO. 167 Date: 1 Dec 67

Loop no.	3(Al/SS)	Housing:	8" I.D. Aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-0	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	1:1 Fine & Coarse AC Dust by wt.	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20, fresh
Date blended with additives: 30 Nov 67
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Monsanto Santolene "C", Lot NH-04006

Test duration, min	33	Calculated dirt loading, g	103
Fuel throughput, gal	660	Actual element weight gain, g	104
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	300	960
Screen ΔP, psi	1	1
Cleanup ΔP, psi	1	2

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	53
IFT, distilled water, dyn/cm	35.9

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.5
ST, dyn/cm	70.6

TABLE 121. SINGLE-ELEMENT LOOP TEST NO. 167 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.9	0	0			80
5	5.4	0	0	0.00	1-2	80
10	8.5	0	0			80
15	17.1	0	0			80
16	20.0	0	0 (a)	0.01	1-2	80
21	29.2	0	1	0.01	2-3	80
26	33.0	0	2		4-5	80
31	34.9	0	4		14-16	80
33	40.0	0	3	neg.	10-12	80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-16	0.002	5.72
	16-31	0.2	----
	31-33	0.2	5.72

(a) 1 min after reaching 20 psi, Effluent Totamitor climbed to a peak of 1, and held this reading for 45 sec and began to fall off. By 2 min Effluent Totamitor read 0. Effluent Totamitor stayed at 0 for 45 sec and began to climb.

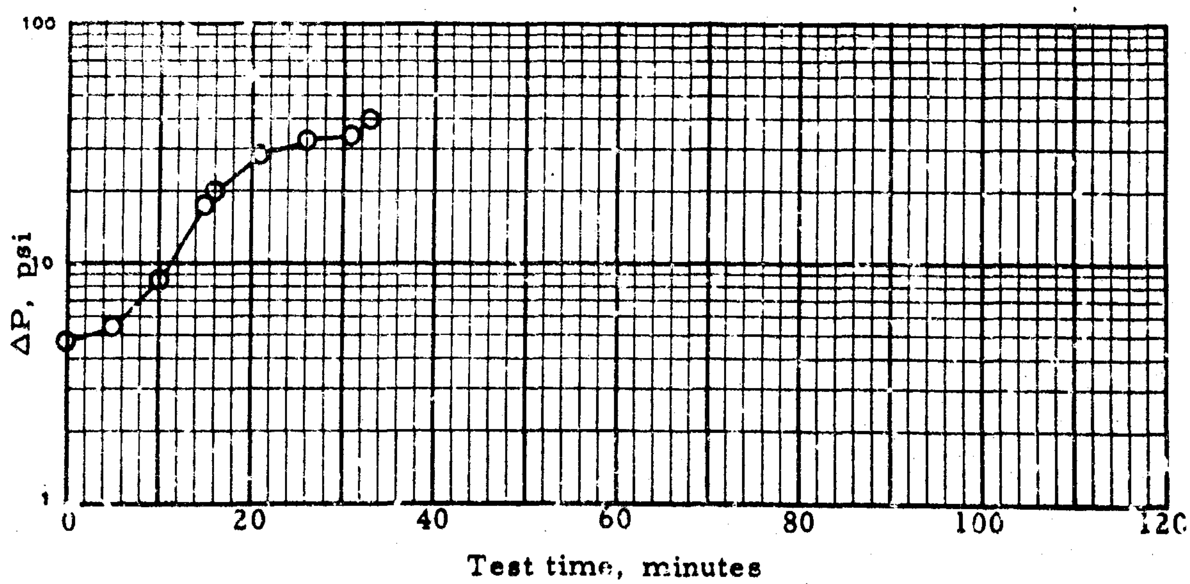


TABLE 122. SINGLE-ELEMENT LOOP TEST NO. 168 Date: 4 Dec 67

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-C		Fuel flow, gpm	20
Water: Filtered tap water		Fuel inlet temperature, °F	80
Solids: 1:1 Fine & Coarse AC Dust by wt.		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20 ,fresh
Date blended with additives: 4 Dec 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Monsanto Santolene "C" , Lot NH-04006

Test duration, min	53	Calculated dirt loading, g	223
Fuel throughput, gal	1064	Actual element weight gain, g	217
Average rate, gpm	20.1		

Time	0 min	End test
Meter reading, gal	298	1362
Screen ΔP, psi	0	0
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	72
IFT, distilled water, dyn/cm	35.1

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.5
pH	7.5
ST, dyn/cm	72.4

TABLE 122. SINGLE-ELEMENT LOOP TEST NO. 168 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids (a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.9	0	0			80
5	5.0	0	0	neg.	1	80
10	5.5	0	0			80
15	6.4	0	0			80
20	8.0	0	0			80
25	10.4	0	0			80
30	15.9	0	0			80
34	20.0	0	0 (b)	0.06	2-3	80
38	20.1	0	0	0.03	2-3	80
44	12.8	0	0		1-2	80
48	13.5	0	0		1-2	80
50	20.5	0	0			80
53	40.0	0	5 (c)	neg.	20	80

Schedule:	Time, min	Water, cpm	Solids, g/min
	0-34	0.002	5.72
	34-48	0.2	----
	48-53	0.2	5.72

(a) Green tint left on test membranes after filtering.
(b) Effluent Totamitor peaked at 3, 40 sec after 20 psi.
(c) Effluent Totamitor climbed to a reading of 4, 1 min before 40 psi, and peaked at 25. Then dropped slowly back to 3.

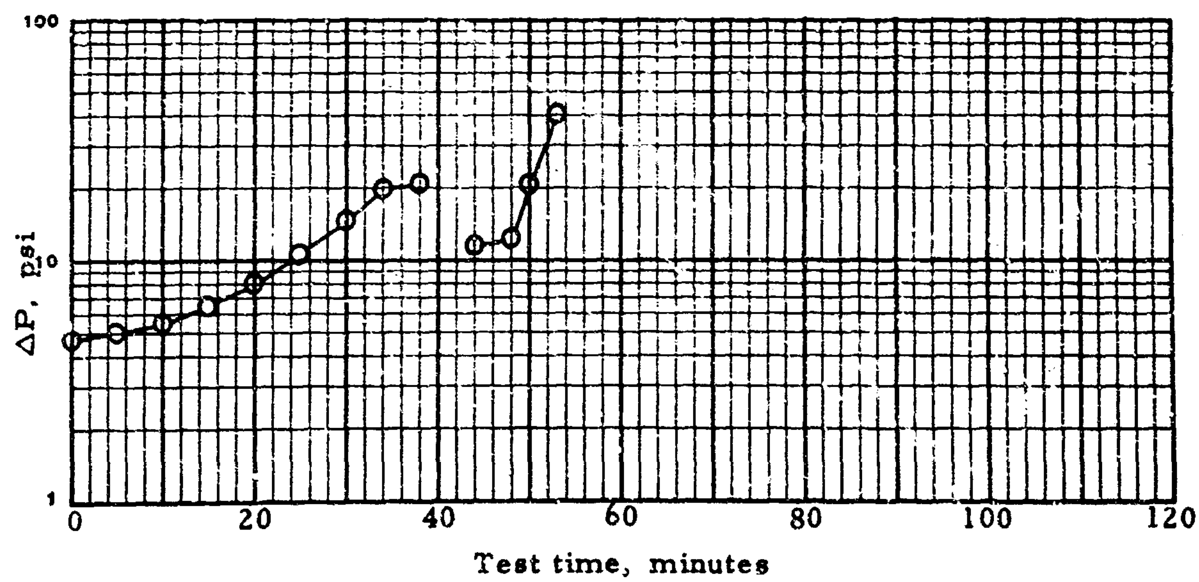


TABLE 123. SINGLE-ELEMENT LOOP TEST NO. 169 Date: 5 Dec 67

Loop no. 3(Al/SS)		Housing: 8" I.D. Aluminum	
		Element: Filters Inc. I-4208 Lot 440-A	
		Canister: DoD type 1	
Procedure no. 13-0		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80
Solids: 1:1 Fine & Coarse AC Dust by wt.		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 4 Dec 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 20 lb/Mbbl, Du Pont RP-2 , Lot 333

Test duration, min	51	Calculated dirt loading, g	206
Fuel throughput, gal	995	Actual element weight gain, g	194
Average rate, gpm	19.5		

Time	0 min	End test
Meter reading, gal	298	1293
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	44
IFT, distilled water, dyn/cm	27.4

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.5
ST, dyn/cm	72.2

TABLE 123. SINGLE-ELEMENT LOOP TEST NO. 169 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.6	0	1			80
5	5.0	0	1	0.09	0-1	80
10	5.5	0	1			80
15	7.4	0	1			80
20	10.0	0	1			80
25	13.0	0	1			80
30	20.0	0	2 (a)	0.06	2-3	80
35	13.0	0	2	0.08	1-2	80
40	13.4	0	2		1-2	80
45	13.5	0	2		1-2	80
50	33.5	0	2			80
51	40.0	0	3	0.03 (b)	7-9	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-30	0.002	5.72
30-45	0.2	----
45-51	0.2	5.72

(a) Effluent Totamitor peaked at a reading of 4, 1 min after 20 psi.
(b) Sample slightly hazy.

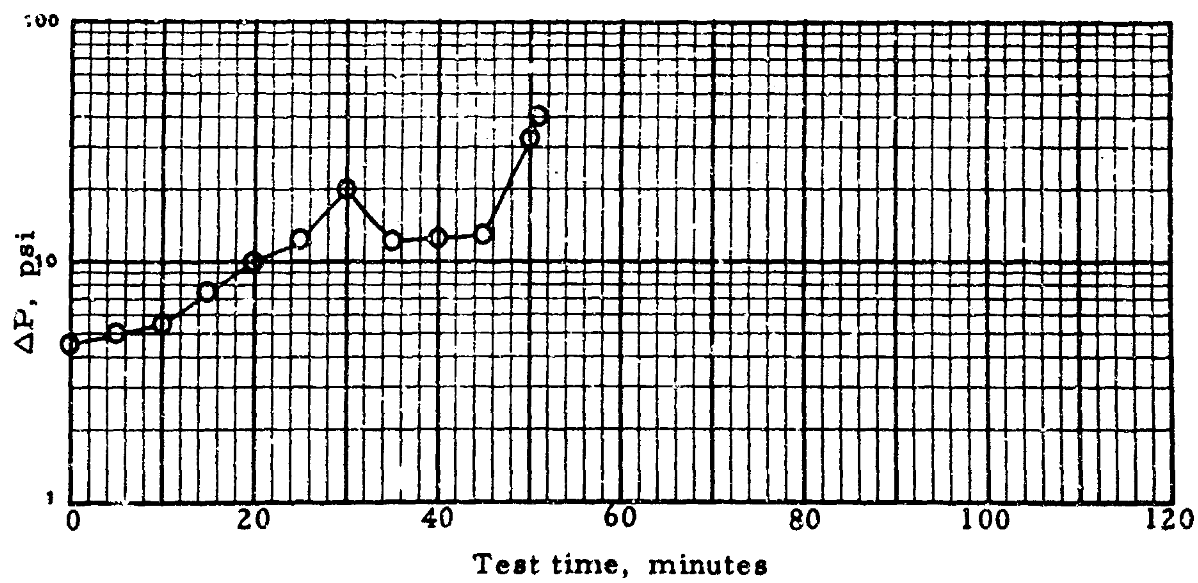


TABLE 124. SINGLE-ELEMENT LOOP TEST NO. 170 Date: 5 Dec 67

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-J
Water: Filtered tap water.
Solids: Fine AC Dust.

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20, fresh
Date blended with additives: 5 Dec 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 20 lb/Mbbl, Du Pont RP-2, Lot 333

Test duration, min 34
Fuel throughput, gal 689
Average rate, gpm 20.3

Calculated dirt loading, g 194
Actual element weight gain, g 214

Time	0 min	End test
Meter reading, gal	320	1009
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	2

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	35
IFT, distilled water, dyn/cm	27.8

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.8
ST, dyn/cm	71.0

TABLE 124. SINGLE-ELEMENT LOOP TEST NO. 170 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water (a)	Influent fuel temperature, °F
0	5.0	0	1			80
5	5.1	0	1	neg.	20+	80
10	5.6	0	1			80
12	5.9	0	1		7-10	80
15	6.2	0	1		5-7	80
20	7.4	0	1			80
25	9.5	0	2			80
30	13.3	0	2			80
34	20.0	0	9	1.06 (b)	5-8	80
34	40.0	0	5			80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-34	0.002	5.72
	34-34	0.2	----

(a) AEL'S used on this test were commercially prepared pads.
(b) 20 and 40 psi samples.

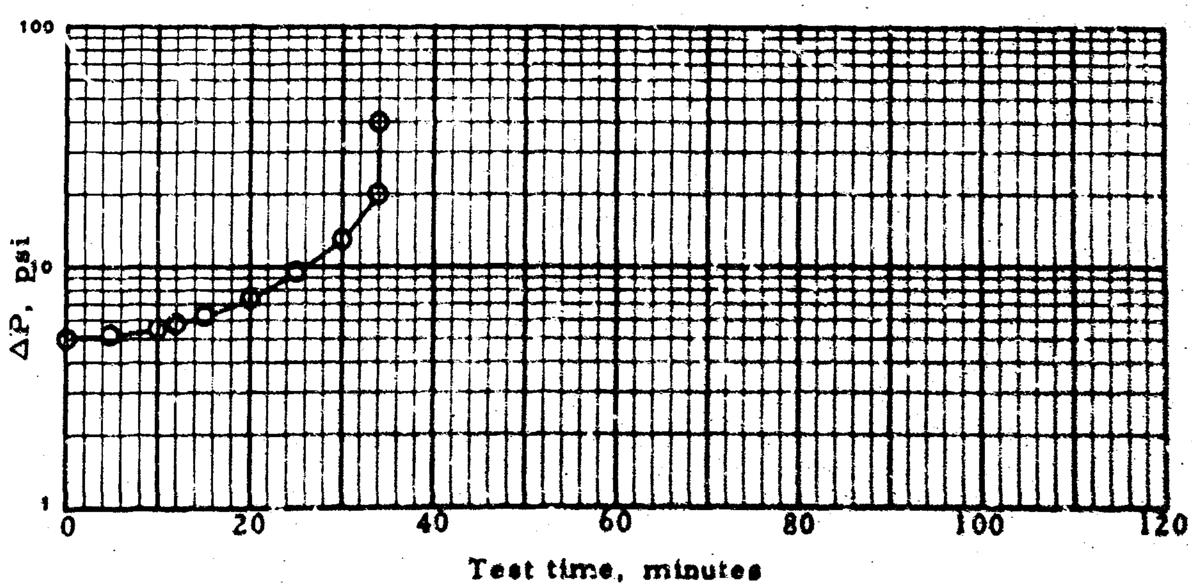


TABLE 125. SINGLE-ELEMENT LOOP TEST NO. 171 Date: 6 Dec 67

Loop no. 3(Al/SS)		Housing:	8" I.D. Aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-N	Fuel flow, gpm	20
Water:	Filtered tap water.	Fuel inlet temperature, °F	80
Solids:	Fine AC Dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 2.86 g/min from 0 min to 20 psi, then discontinued 15 min, then 2.86 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 6 Dec 67
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 20 lb/Mbbl, Du Pont RP-2 , Lot 333

Test duration, min	76	Calculated dirt loading, g	214
Fuel throughput, gal	1510	Actual element weight gain, g	216
Average rate, gpm	19.9		

Time	0 min	End test
Meter reading, gal	334	1844
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	2

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	33
IFT, distilled water, dyn/cm	27.1

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.4
ST, dyn/cm	71.0

TABLE 125. SINGLE-ELEMENT LOOP TEST NO. 171 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	5.1	0	0			80
5	5.4	0	0	neg.	0	80
10	5.3	0	0			80
15	5.5	0	0			81
20	5.8	0	0			80
25	6.0	0	0			80
30	6.4	0	0			80
35	6.7	0	0			80
40	7.3	0	0			80
45	7.9	0	0			80
50	8.6	0	0			80
55	9.3	0	0			80
60	10.4	0	0			80
65	11.6	0	0			80
70	14.1	0	0			80
75	20.0	0	0	0.60	17-19	80
76	40.0	0	18	0.61	19-20	80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-75	0.002	2.86
	75-76	0.2	---

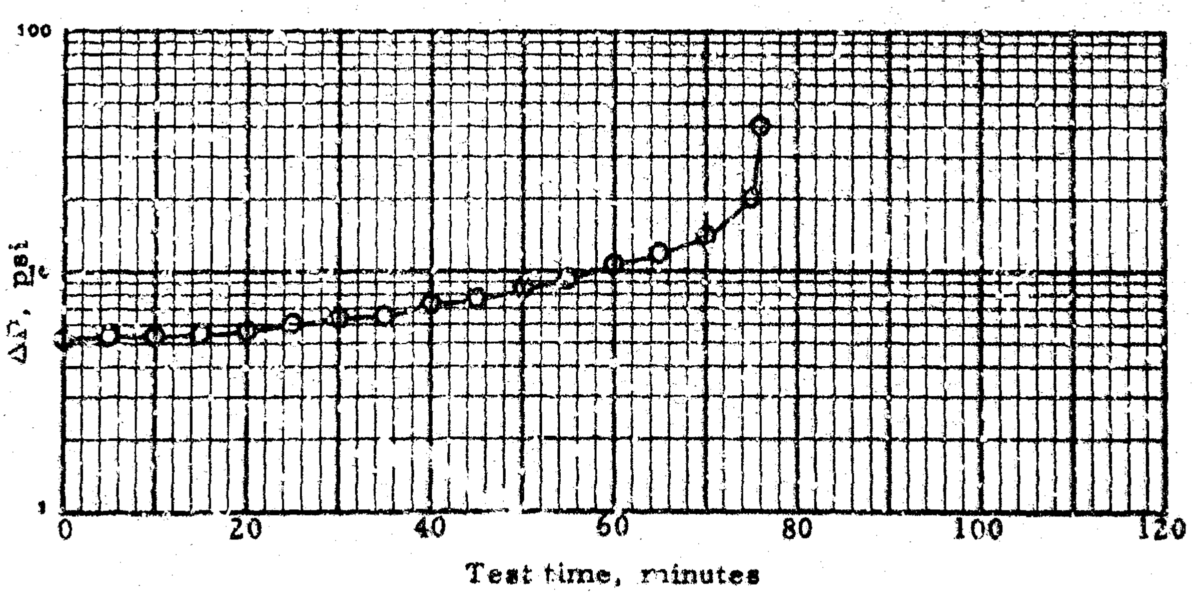


TABLE 126. SINGLE-ELEMENT LOOP TEST NO. 172 Date: 7 Dec 67

Loop no. 3(A1/SS)		Housing: 8" I.D. Aluminum	
		Element: Filters Inc. I-4208 Lot 440-A	
		Canister: DoD type 1	
Procedure no. 13-J		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	8
Solids: Fine AC Dust.		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 7 Dec 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03137126
Corrosion inhibitor 7 lb/Mbbl, Du Pont RP-2 , Lot 333

Test duration, min	45	Calculated dirt loading, g	257
Fuel throughput, gal	907	Actual element weight gain, g	255
Average rate, gpm	20.2		

Time	0 min	End test
Meter reading, gal	300	1207
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	39
IFT, distilled water, dyn/cm	30.6

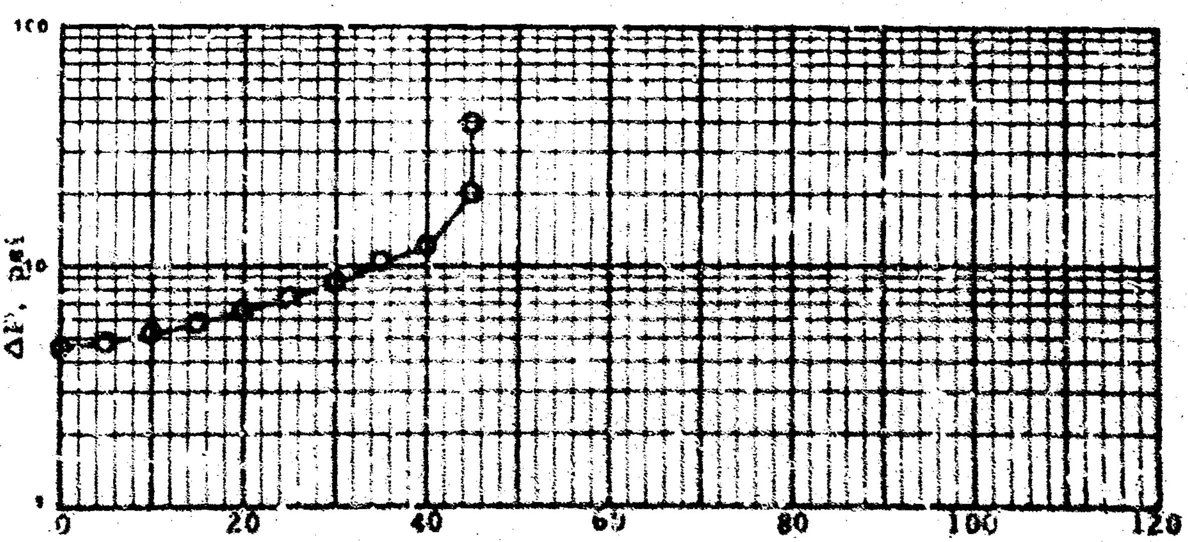
Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.6
ST, dyn/cm	71.6

TABLE 126. SINGLE-ELEMENT LOOP TEST NO. 172 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.7	0	0			80
5	4.9	0	0	0.03	0	80
10	5.2	0	0			80
15	5.9	0	0			80
20	6.5	0	1			80
25	7.4	0	1			80
30	8.6	0	1			80
35	10.3	0	1			80
40	13.4	0	1			80
45	20.0	0	1	0.28	10-12	80
45	40.0	0	15	0.48	19-20	80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-45	0.002	5.72
	45-45	0.2	----



Test time, minutes

TABLE 127. SINGLE-ELEMENT LOOP TEST NO. 173 Date: 11 Dec 67

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-N
Water: Filtered tap water.
Solids: Fine AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	70
Fuel inlet pressure, psi	30

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 2.86 g/min from 0 min to 20 psi, then discontinued 15 min, then 2.86 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 11 Dec 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03137126
Corrosion inhibitor 7 lb/Mbbl, Du Pont RP-2 , Lot 333

Test duration, min	89	Calculated dirt loading, g	254
Fuel throughput, gal	1787	Actual element weight gain, g	255
Average rate, gpm	20.1		

Time	0 min	End test
Meter reading, gal	301	2088
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	49
IFT, distilled water, dyn/cm	30.5

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.5
ST, dyn/cm	71.4

TABLE 127. SINGLE-ELEMENT LOOP TEST NO. 173 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.5	0	0			80
5	4.7	0	0	neg.	1-2	80
10	4.8	0	0			80
15	4.9	0	0			80
20	5.0	0	0			80
25	5.2	0	0			80
30	5.5	0	0			80
35	5.9	0	0			80
40	6.2	0	0			80
45	6.6	0	0			80
50	7.1	0	0			80
55	7.6	0	0			80
60	8.2	0	0			80
65	9.0	0	0			80
70	9.9	0	0			80
75	12.1	0	0			80
80	12.8	0	0			80
85	16.0	0	0			80
89	20.0	0	1		2-3	80
89	40.0	0	24	1.08 (a)	18-20	80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-89	0.002	2.86
	89-89	0.2	----

(a) 20 & 40 psi sample due to time; also AC Dust present on test membrane.

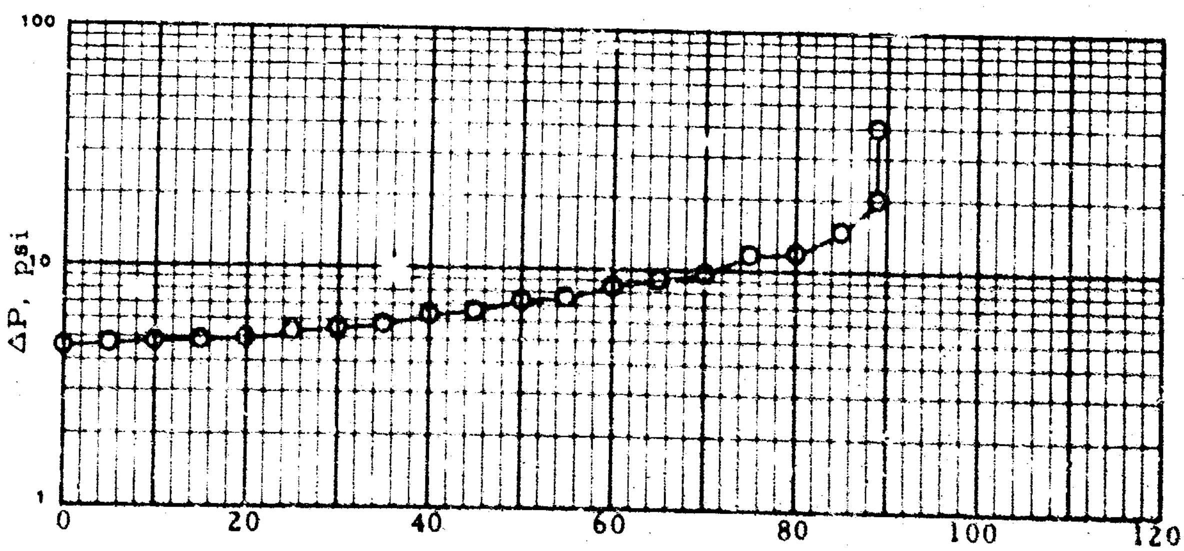


TABLE 128. SINGLE-ELEMENT LOOP TEST NO. 174 Date: 12 Dec 67

Loop no. 3(A1/3S)		Housing: 8" I.D. Aluminum	
		Element: Filters Inc. I-4208 Lot 440-A	
		Canister: DoD type 1	
Procedure no. 13-0		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80
Solids: 1:1 Fine & Coarse AC Dust by wt.		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20 ,fresh
Date blended with additives: 12 Dec 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min	50	Calculated dirt loading, g	200
Fuel throughput, gal	1005	Actual element weight gain, g	187
Average rate, gpm	20.1		

Time	0 min	End test
Meter reading, gal	300	1305
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	55
IFT, distilled water, dyn/cm	23.9

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.5
ST, dyn/cm	71.7

TABLE 128. SINGLE-ELEMENT LOOP TEST NO. 174 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.1	0	0			80
5	4.4	0	0	0.01	0	80
10	4.6	0	0			80
15	5.3	0	0			80
20	7.5	0	0			80
25	11.0	0	0			80
30	16.5	0	0			80
32	20.0	0	0 (a)	0.16	1-2	80
37	20.5	0	4	0.01	14-15	80
42	20.5	0	5		9-10	80
47	20.2	0	5		9-10	80
50	40.0	0	4	0.12	12-13	80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-32	0.002	5.72
	32-47	0.2	----
	47-50	0.2	5.72

(a) Initial time of peaking started at 20 psi, and lasted for a period of 100 sec. Also a peak value of 6 occurred at 70 sec.

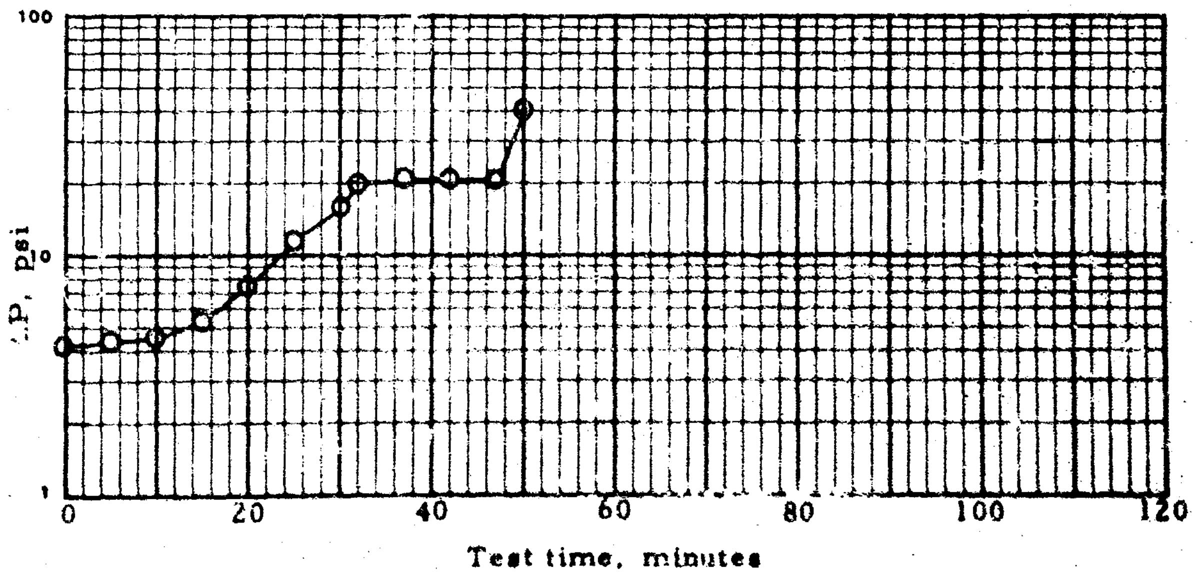


TABLE 129. SINGLE-ELEMENT LOOP TEST NO. 175 Date: 13 Dec 67

Loop no.	3(Al/SS)	Housing:	8" I.D. Aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no. 13-0		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80
Solids: 1:1 Fine & Coarse AC Dust by wt.		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 20 , fresh
Date blended with additives: 12 Dec 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min	49	Calculated dirt loading, g	194
Fuel throughput, gal	982	Actual element weight gain, g	196
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	298	1280
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	66
IFT, distilled water, dyn/cm	23.4

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.5
ST, dyn/cm	72.1

TABLE 129. SINGLE-ELEMENT LOOP TEST NO. 175 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.5	0	0			80
5	4.7	0	0	0.04	0-1	80
10	5.2	0	0			80
15	6.2	0	0			80
20	8.8	0	0			80
25	12.2	0	0			80
30	18.9	0	0			80
31	20.0	0	0 (a)	0.10	0-1	80
36	20.4	0	3	neg.	7-8	80
41	20.5	0	4		10-12	80
46	21.5	0	4		15-16	80
49	40.0	0	9	0.01	8-10	80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-31	0.002	5.72
	31-46	0.2	----
	46-49	0.2	5.72

(a) Initial time of peaking started at 20 psi and lasted for 90 sec. Also a peak value of 4 occurred at 67 sec. The second peaking occurred 15 min after 20 psi and lasted for a period of [illegible] min. A peak value of 20 was reached 2 min later, after 20 psi + 15 min.

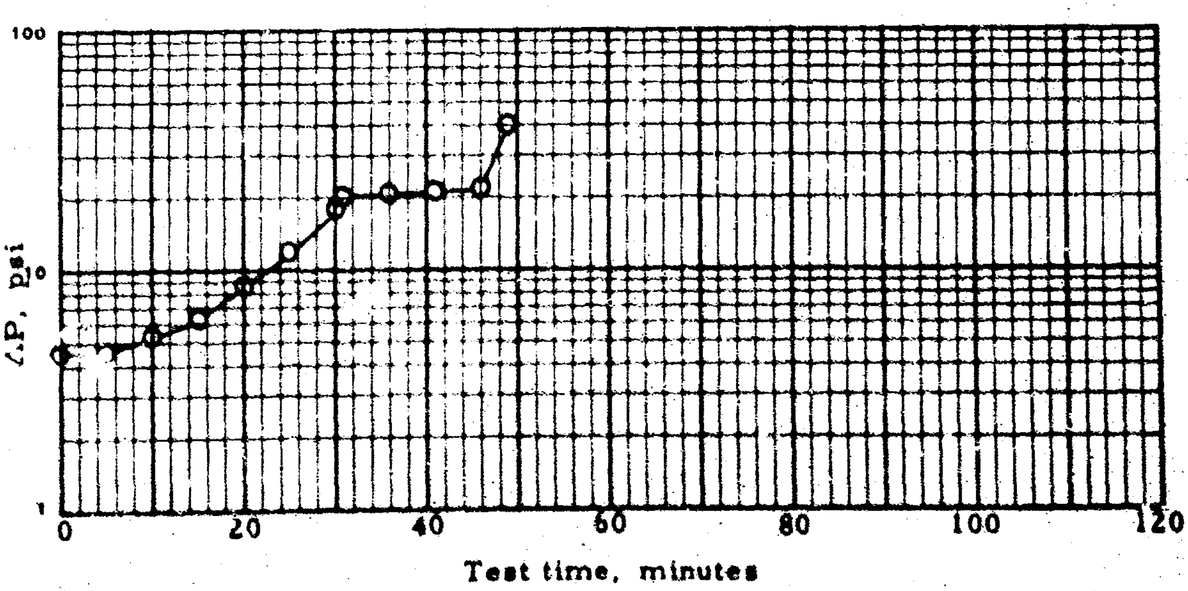


TABLE 130. SINGLE-ELEMENT LOOP TEST NO. 176 Date: 19 Dec 67

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-J
Water: Filtered tap water.
Solids: Fine AC Dust

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21, fresh
Date blended with additives: 18 Dec 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 9 lb/Mbbl, Univeral Oil Products Unicor "M", Lot 0020

Test duration, min 36
Fuel throughput, gal 710
Average rate, gpm 19.7

Calculated dirt loading, g 172
Actual element weight gain, g 169

Time	0 min	End test
Meter reading, gal	300	1010
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	58
IFT, distilled water, dyn/cm	33.3

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.5
ST, dyn/cm	70.6

TABLE 130. SINGLE-ELEMENT LOOP TEST NO. 176 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids (a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	5.0	0	0			80
5	5.0	0	0	0.08	0	80
10	5.4	0	0			80
15	6.6	0	0			80
20	8.2	0	0			80
25	11.9	0	0			80
30	20.0	0	1 (b)	0.04	1-2	80
35	38.5	0	1	0.01 (c)	2-3	80
36	40.0	0	1		4-5	80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-35	0.002	5.72
	35-36	0.2	----

(a) AC Dust present on test membranes.
(b) At 20 psi + 45 sec, Effluent Totamitor began to climb and lasted for a period of 75 sec. Also at 20 psi + 60 sec a peak value of 5 was reached.
(c) 20 psi + 5 min & 40 psi sample, due to time interval.

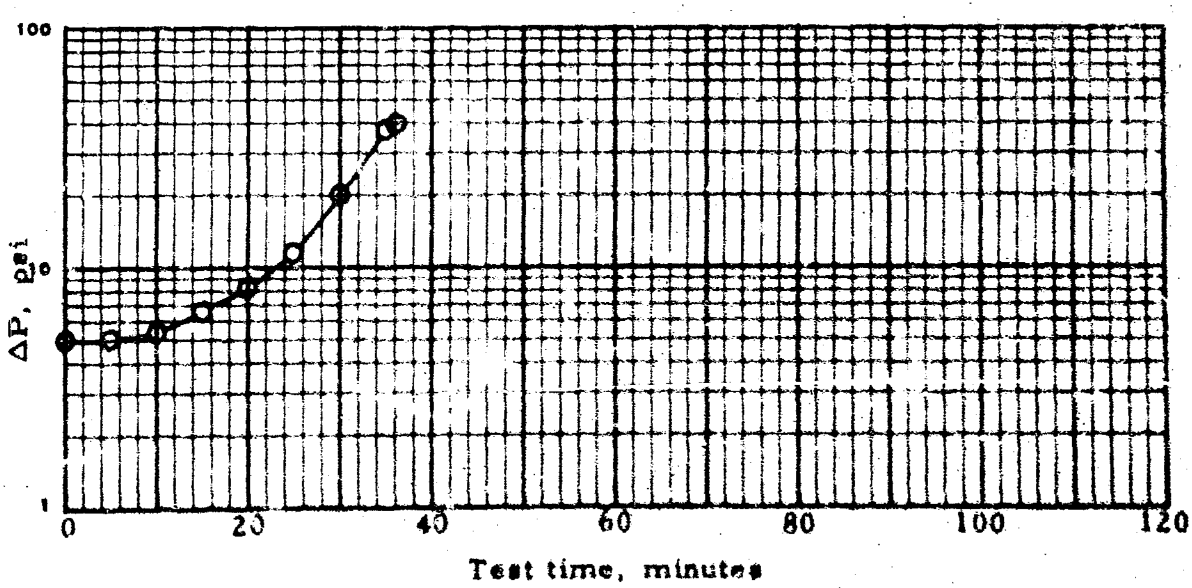


TABLE 131. SINGLE-ELEMENT LOOP TEST NO. 177 Date: 19 Dec 67

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-J
Water: Filtered tap water.
Solids: Fine AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.[illegible] gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 **batch no.** 21 , fresh
Date blended with additives: 19 Dec 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 9 lb/Mbbl, Universal Oil Products , Lot 0020 Unicor"M"

Test duration, min	50	Calculated dirt loading, g	257
Fuel throughput, gal	1001	Actual element weight gain, g	243
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	322	1323
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	60
IFT, distilled water, dyn/cm	32.7

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.7
ST, dyn/cm	71.7

TABLE 131. SINGLE-ELEMENT LOOP TEST NO. 177 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.1	0	0			80
5	4.3	0	0	0.00	0-1	80
10	4.6	0	0			80
15	5.0	0	0			80
20	5.5	0	0			80
25	6.0	0	0			80
30	7.5	0	1			80
35	9.4	0	1			80
40	12.3	0	1			80
45	20.0	0	1 (a)	0.31	4-5	80
50	40.0	0	27	0.17	20+	80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-45	0.002	5.72
	45-50	0.2	----

(a) Effluent Totamitor began to climb 45 sec after 20 psi, and lasted for a period of 1 min. A peak value of 17 was reached 75 sec after 20 psi.

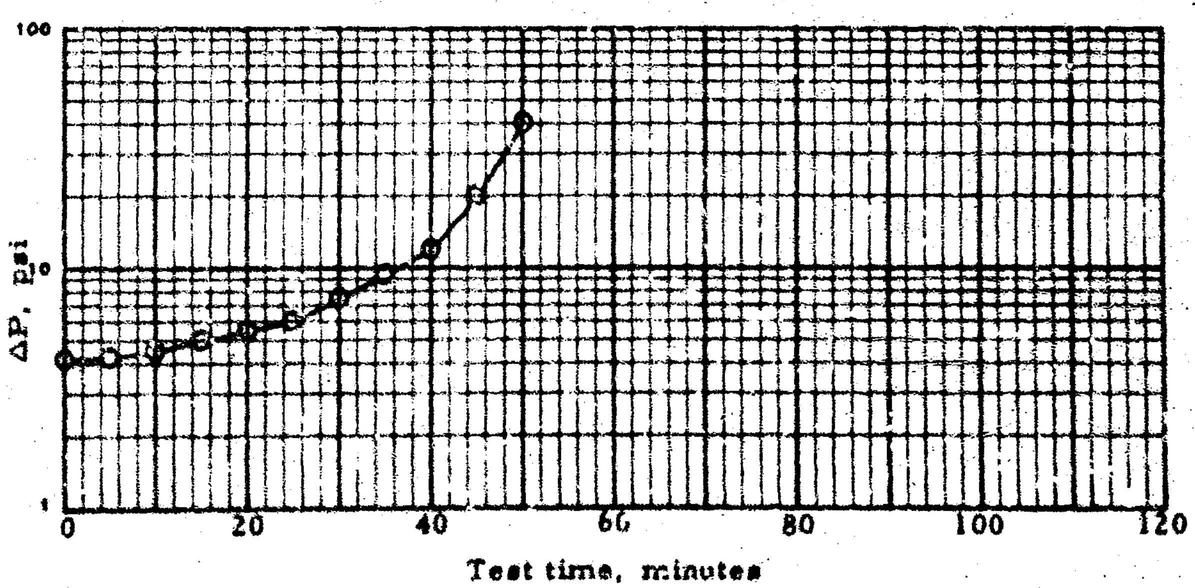


TABLE 132. SINGLE-ELEMENT LOOP TEST NO. 178 Date: 20 Dec 67

Loop no. 3(Al/SS)		Housing: 8" I.D. Aluminum	
		Element: Filters Inc. I-4208 Lot 420-A	
		Canister: DoD type 1	
Procedure no. 13-J		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80
Solids: Fine AC Dust		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 19 Dec 67
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 20 lb/Mbbl, Universal Oil Products , Lot 0020
Unicor "M"

Test duration, min	26	Calculated dirt loading, g	137
Fuel throughput, gal	517	Actual element weight gain, g	136
Average rate, gpm	19.9		

Time	0 min	End test
Meter reading, gal	298	815
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	32
IFT, distilled water, dyn/cm	26.5

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.6
ST, dyn/cm	71.6

TABLE 132. SINGLE-ELEMENT LOOP TEST NO. 178 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.8	0	0			80
5	5.2	0	0	0.01	2-3	80
10	6.6	0	0			80
15	8.4	0	0			80
20	12.4	0	0			80
24	20.0	0	1 (a)	0.52 (b)	3-4	80
26	40.0	0	31		20+	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-24	0.002	5.72
24-26	0.2	----

(a) Effluent Totamitor began to climb at 20 psi + 40 sec and lasted for a period of 50 sec. Also a peak value of 34 occurred at 45 sec into this period.
(b) 20 & 40 psi sample due to time interval. Also AC Dust present on test membrane.

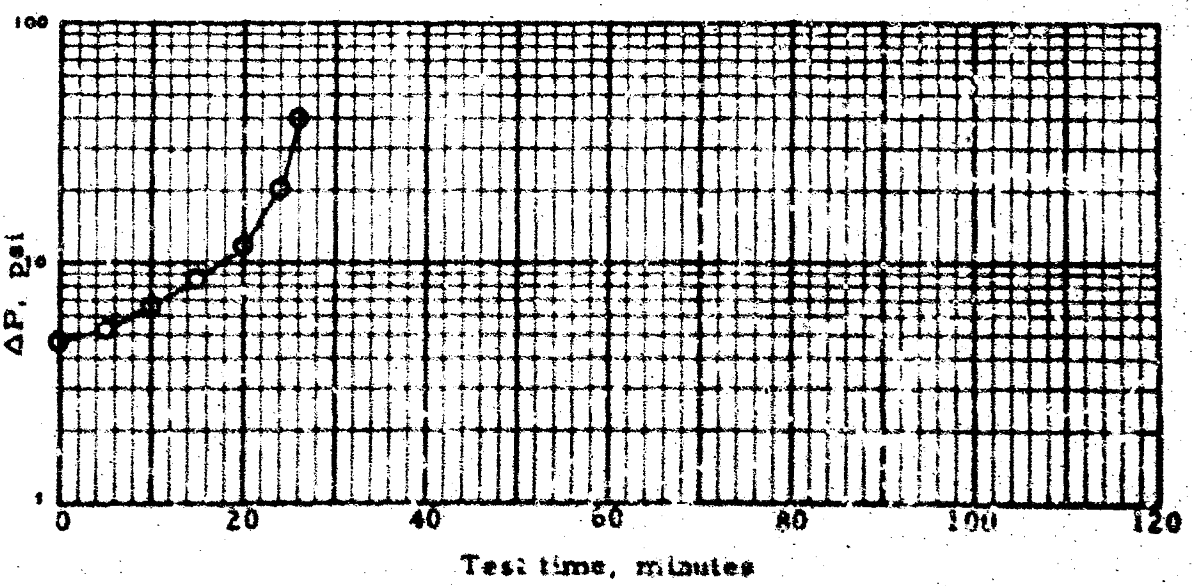


TABLE 133. SINGLE-ELEMENT LOOP TEST NO. 179 Date: 21 Dec 67

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-J
Water: Filtered tap water.
Solids: Fine AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.00? gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 20 Dec 67
Anti-icing additive 0.15 vol.%, Dow, Lot 03137126
Corrosion inhibitor 20 lb/Mbbl, Universal Oil Products , Lot 0020 Unicor"M"

Test duration, min	38	Calculated dirt loading, g	217
Fuel throughput, gal	755	Actual element weight gain, g	202
Average rate, gpm	19.9		

Time	0 min	End test
Meter reading, gal	300	1055
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	40
IFT, distilled water, dyn/cm	24.7

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.8
ST, dyn/cm	73.8

TABLE 133. SINGLE-ELEMENT LOOP TEST NO. 179 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Eff	Effluent, mg/liter Solids(a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.4	0	0			80
5	4.6	0	0	0.14	0-1	80
10	4.9	0	0			80
15	5.5	0	0			80
20	6.4	0	1			80
25	7.1	0	1			80
30	9.4	0	1			80
35	15.2	0	2			80
37	20.0	0	2 (b)	0.95 (c)	20+	80
38	40.0	0	5			80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-37	0.002	5.72
	37-38	0.2	----

(a) AC Dust present on test membranes.
(b) Effluent Totamitor began to climb 10 sec after 20 psi and lasted for 20 sec. A peak value occurred at the end of this 20 sec period which was 5.
(c) 20 & 40 psi sample, due to time period.

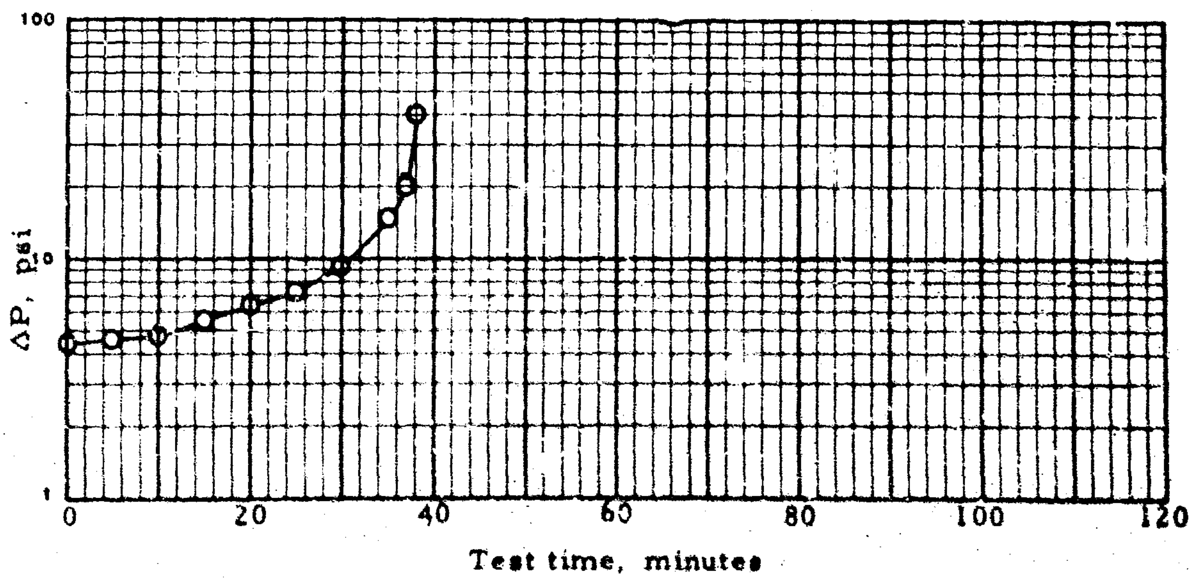


TABLE 134. SINGLE-ELEMENT LOOP TEST NO. 180 Date: 5 Jan 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-0
Water: Filtered tap water
Solids: 1:1 Fine & Coarse AC Dust by wt

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 4 Jan 68
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 9 lb/Mbbl, Universal Oil Products , Lot 0020
Unicor "M"

Test duration, min	52	Calculated dirt loading, g	212
Fuel throughput, gal	1032	Actual element weight gain, g	180
Average rate, gpm	19.8		

Time	0 min	End test
Meter reading, gal	298	1330
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	73
IFT, distilled water, dyn/cm	32.9

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.9
ST, dyn/cm	70.1

TABLE 134. SINGLE-ELEMENT LOOP TEST NO. 180 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.5	0	0			80
5	4.5	0	0	0.25	0	82
10	4.9	0	0			80
15	5.2	0	0			80
20	6.6	0	0			80
25	10.8	0	0			80
30	14.7	0	0			80
33	20.0	0	1 (a)	0.15 (b)	1-3	80
38	20.6	0	0		1-3	80
43	21.0	0	2		1-3	80
48	21.2	0	1		1-3	80
50	30.2	0	1			80
52	40.0	0	3	0.11	2-3	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-33	0.002	5.72
33-48	0.2	----
48-52	0.2	5.72

(a) Initial time of peaking started at 20 psi + 25 sec and lasted for a period of 30 sec. A peak value of 4 occurred at 20 psi + 40 sec.

(b) Sample cloudy when pulled.

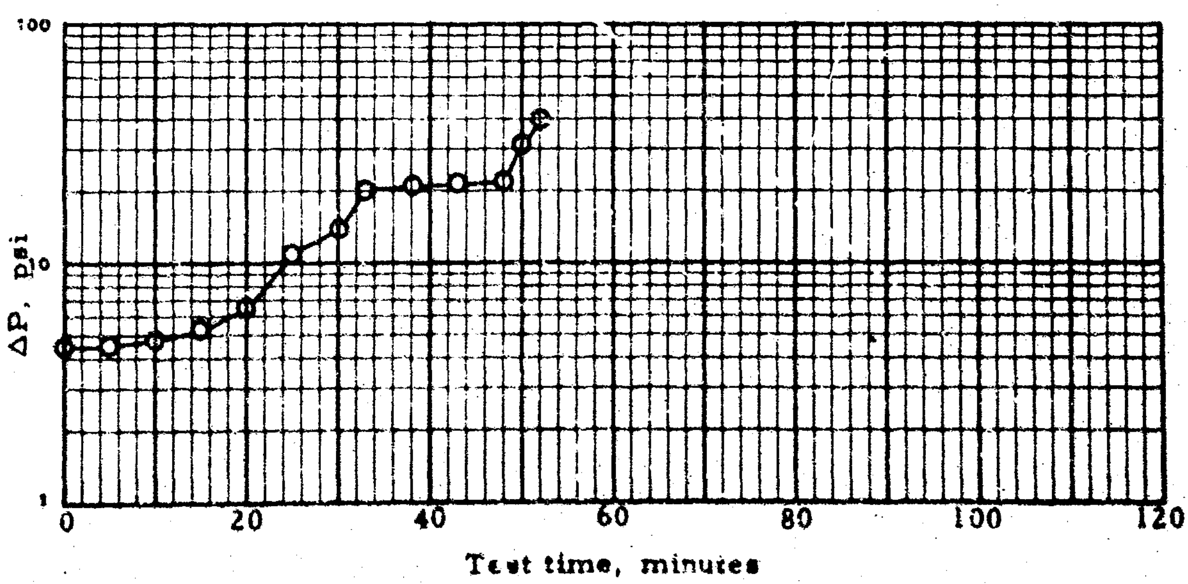


TABLE 135. SINGLE-ELEMENT LOOP TEST NO. 181 Date: 9 Jan 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-0
Water: Filtered tap water.
Solids: 1:1 Fine & Coarse AC Dust by wt

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 **batch no.** 21 **, fresh**
Date blended with additives: 9 Jan 68
Anti-icing additive 0.15 **vol. %, Dow, Lot** C3187126
Corrosion inhibitor 9 **lb/Mbbl,** Universal Oil Products **, Lot** 0020
Unicor"M"

Test duration, min	67	**Calculated dirt loading, g**	297
Fuel throughput, gal	1345	**Actual element weight gain, g**	226
Average rate, gpm	20.1		

Time	0 min	End test
Meter reading, gal	300	1645
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	67
IFT, distilled water, dyn/cm	36.6

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	8.0
ST, dyn/cm	72.3

TABLE 135. SINGLE-ELEMENT LOOP TEST NO. 181 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.9	0	0			80
5	5.0	0	0	0.12	0-1	80
10	5.4	0	0			80
15	5.6	0	0			80
20	6.1	0	0			80
25	7.1	0	0			80
30	8.6	0	0			80
35	10.2	0	0			80
40	12.0	0	0			80
45	15.3	0	0			80
49	20.0	0	0 (a)	0.20	3-4	80
54	21.9	0	35	0.15	20+++	80
59	22.5	0	30		20+	80
64	23.0	0	28		20+++	80
65	28.5	0	30			80
67	40.0	0	2	0.18	2-3	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-49	0.002	5.72
49-64	0.2	----
64-67	0.2	5.72

(a) Initial time of peaking started at 20 psi + 40 sec, and lasted for a period of 65 sec. A peak reading of 37 occurred at 35 sec.

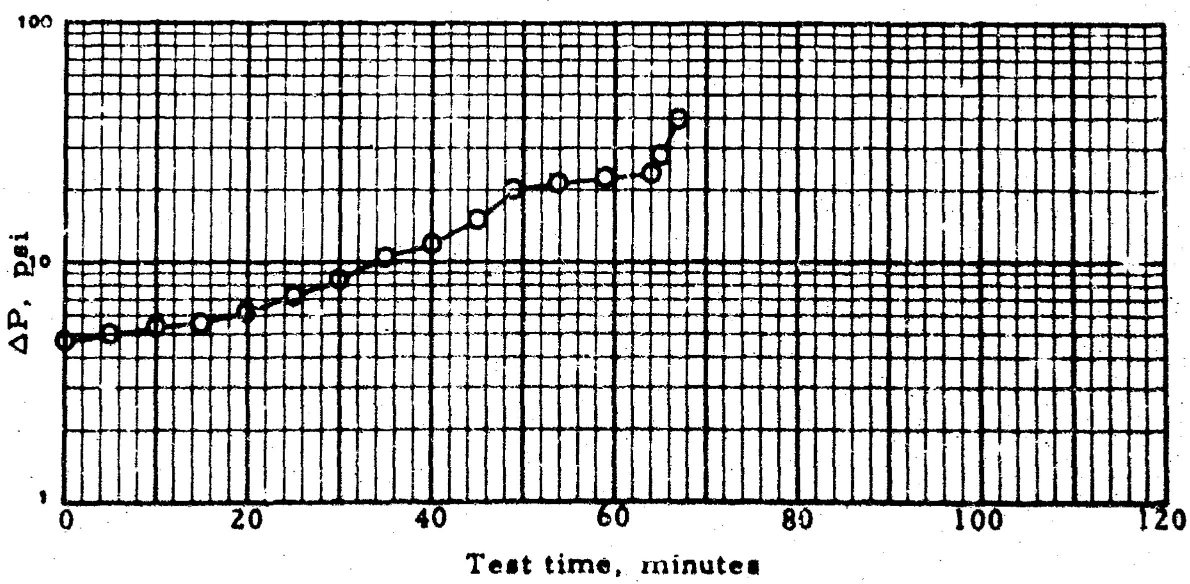


TABLE 136. SINGLE-ELEMENT LOOP TEST NO. 182 Date: 10 Jan 68

Loop no. 3(Al/SS)		Housing: 8" I.D. Aluminum	
		Element: Filters Inc. I-4208 Lot 440-A	
		Canister: DoD type 1	
Procedure no. 13-0		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80
Solids: 1:1 Fine & Coarse AC Dust by wt		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel: JP-5 batch no. 21 , fresh
Date blended with additives: 9 Jan 68
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 20 lb/Mbbl, Universal Oil Products , Lot 0020
Unicor "M"

Test duration, min	48	Calculated dirt loading, g	269
Fuel throughput, gal	964	Actual element weight gain, g	227
Average rate, gpm	20.1		

Time	0 min	End test
Meter reading, gal	300	1264
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	33
IFT, distilled water, dyn/cm	25.0

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.3
pH	8.0
ST, dyn/cm	72.2

TABLE 136. SINGLE-ELEMENT LOOP TEST NO. 182 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.5	0	0			80
5	4.7	0	0	0.14	0-1	80
10	4.8	0	0			80
15	5.1	0	0			80
20	5.5	0	0			80
25	6.2	0	0			80
30	7.2	0	0			80
35	9.0	0	0			80
40	12.2	0	0			80
45	17.2	0	1			80
47	20.0	0	1 (a)	0.26 (b)	10-12	80
48	40.0	0	24		20+	

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-47	0.002	5.72
	47-48	0.2	----

(a) Effluent Totamitor started to climb at 20 psi + 30 sec and lasted for a period of 50 sec, at which time, it also showed a peak value of 24.
(b) 20 & 40 psi samples.

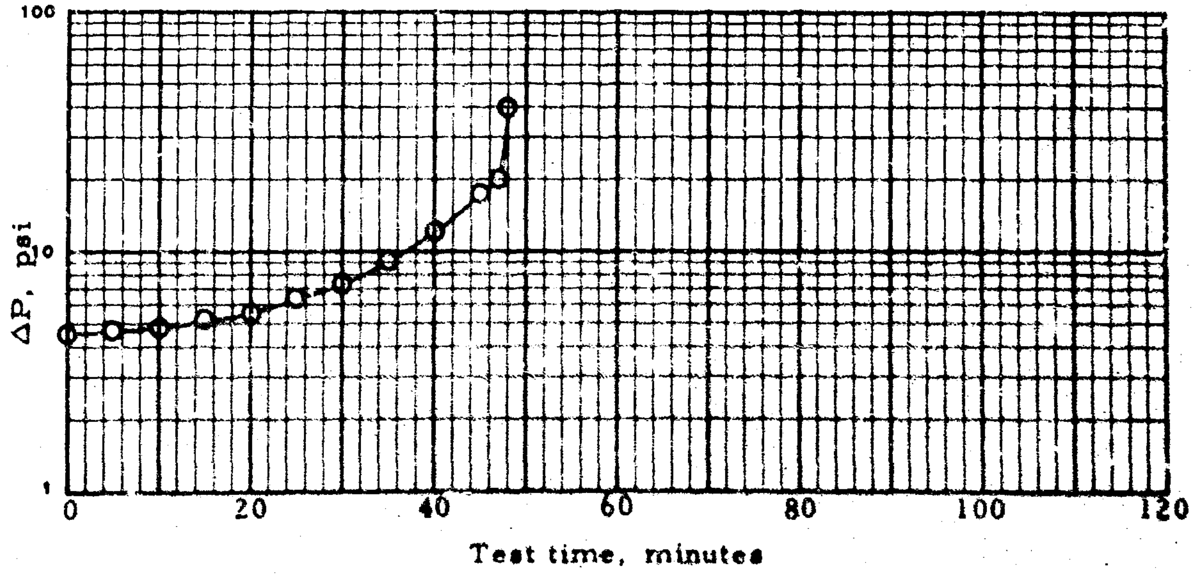


TABLE 137. SINGLE-ELEMENT LOOP TEST NO. 183 Date: 11 Jan 68

Loop no. 3(Al/SS)		Housing: 8" I.D. Aluminum	
		Element: Filters Inc. I-4208 Lot 440-A	
		Canister: DoD type 1	
Procedure no. 13-0		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80
Solids: 1:1 Fine & Coarse AC Dust by wt		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 11 Jan 68
Anti-icing additive 0.15 vol. %, Dow, Lot 03137126
Corrosion inhibitor 20 lb/Mbbl, Universal Oil Products, Lot 0020 Unicor™

Test duration, min	23	Calculated dirt loading, g	126
Fuel throughput, gal	465	Actual element weight gain, g	136
Average rate, gpm	20.2		

Time	0 min	End test
Meter reading, gal	520	985
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test*
WSIM, distilled water	38
IFT, distilled water, dyn/cm	24.8

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.3
pH	7.3
ST, dyn/cm	71.2

* Pre-test was discontinued due to faulty water; because grease was found in H_2O injection tank. The H_2O injection was then flushed with isopropanol for 20 min. and rinsed with tap H_2O for 30 min. Total time of shutdown was 1 hr. Pre-test was then run for an extra 11 min to make sure that all grease was out of injection system. Total pre-test time: 25min.

TABLE 137. SINGLE-ELEMENT LOOP TEST NO. 183 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	5.0	0	0			80
5	5.3	0	0	0.16	0-1	80
10	5.8	0	0			80
15	7.2	0	0			80
20	15.0	0	2			80
22	20.0	0	2 (a)	0.53 (b)	10-12	80
23	40.0	0	63		20+	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-22	0.002	5.72
22-23	0.2	----

(a) Effluent Totamitor began to climb at 20 psi + 30 sec for a period of 30 sec, at which time, a peak value of 63 occurred.
(b) 20 & 40 psi sample.

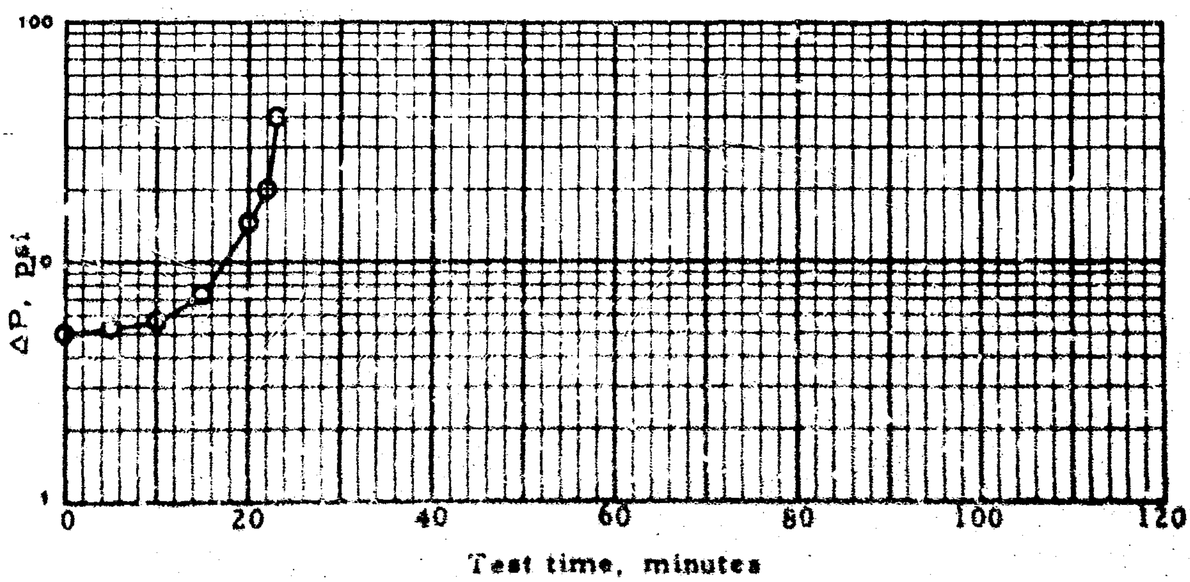


TABLE 138. SINGLE-ELEMENT LOOP TEST NO. 184 Date: 15 Jan 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 15 Jan 68
Anti-icing additive 0 vol.%, Dow, Lot
Corrosion inhibitor 0 lb/Mbbl,
Surfactant 1.0 mg/liter (0.35 lb/Mbbl) Petronate L (Witco). Lot 6S1079

Test duration, min	29	Calculated dirt loading, g	160
Fuel throughput, gal	581	Actual element weight gain, g	120
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	600	1181
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test*	Post-test
WSIM, distilled water	95	59	35	35
IFT, distilled water, dyn/cm	41.2	38.2	40.2	39.2

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.4
ST, dyn/cm	72.2

* Pre-test was run an extra 1 min, bypassing test housing, due to a Effluent Totamitor reading of 9.

TABLE 138. SINGLE-ELEMENT LOOP TEST NO. 184 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids (a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.9	0	1 (b)			80
5	4.1	0	5	1.13 (c)	4-5	80
8	4.3	0	13		19-20	80
10	4.4	0	24			80
13	4.6	2	38			80
15	5.0	2	46			80
20	6.2	5	56	8.51 (d)	20+	80
25	10.2	6	72			80
27	14.5	7	81		0-1	80
28	20.0	8	77	8.32 (e)	20+	80
29	40.0	9	100+		20+++	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-28	0.002	5.72
28-29	0.2	----

(a) AC Dust present on test membranes.
(b) 40 sec after water and solids injection Effluent Totamitor began to rise. Peak values of : 73 at 20 min 15 sec, 90 at 26 min 15 sec, 87 at 26 min 50 sec, and 100+ at 28 min 20 sec, 40 psi. Interval lasted 28 min 20 sec.
(c) Slightly cloudy.
(d) Special sample.
(e) Qt sample.

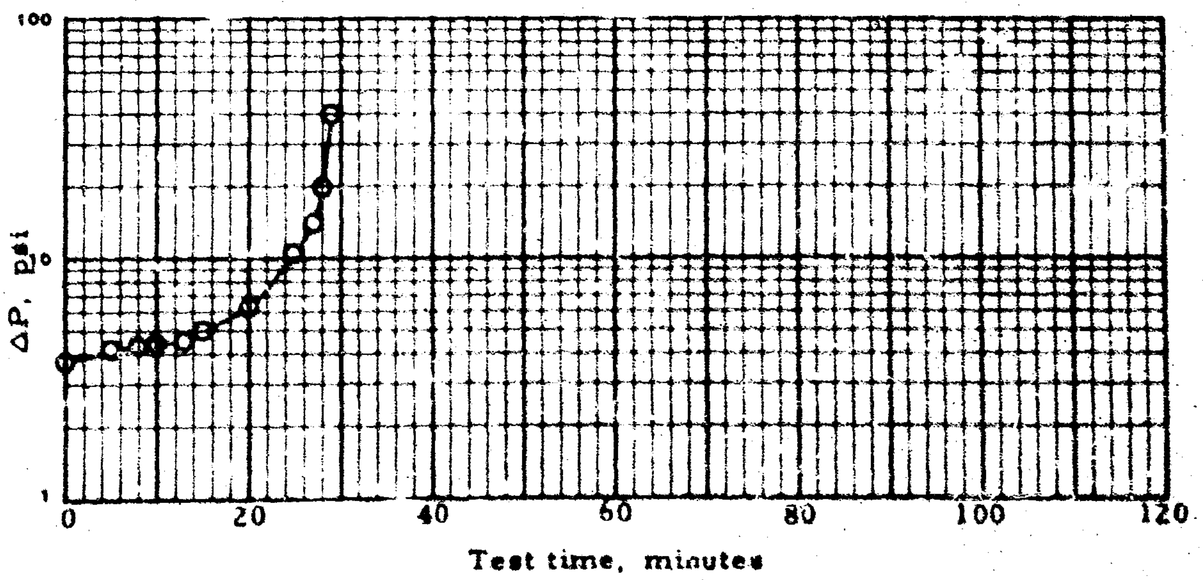


TABLE 139. SINGLE-ELEMENT LOOP TEST NO. 185 Date: 17 Jan 68

Loop no. 3(A1/SS)		Housing: 8" I.D. Alumin	
		Element: Filters Inc. I-4208 Lot 440-A	
		Canister: DoD type 1	
Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water.	Fuel inlet temperature, °F	80
Solids:	Coarse AC Dust.	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 16 Jan 68
Anti-icing additive 0 vol. %, Dow, Lot
Corrosion inhibitor 0 lb/Mbbl,
Surfactant 0.2 mg/liter (0.07 lb/Mbbl) Petronate L (Witco), Lot 6S1079

Test duration, min	44	Calculated dirt loading, g	229
Fuel throughput, gal	877	Actual element weight gain, g	220
Average rate, gpm	19.9		

Time	0 min	End test
Meter reading, gal	1199	2076
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test*	Post-test
WSIM, distilled water	95	55	59	69
IFT, distilled water, dyn/cm	42.2	40.9	43.9	42.9

Analyses on injection water:

Time	Post test
Solids, mg/liter	0.4
pH	7.5
ST, dyn/cm	71.[illegible]

*Pre-test extended an extra 45 min due to a indication of water by Effluent Totamitor.

TABLE 139. SINGLE-ELEMENT LOOP TEST NO. 185 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids (a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.7	0	2			80
5	3.9	0	4	0.64	1-2	80
10	4.[illegible]	0	20			80
15	4.6	0	27			80
20	5.8	0	33			80
21	[illegible].4	1	37			60
25	8.0	2	38			80
30	10.4	2	44			80
32	11.5	3	57		0	80
35	13.7	3	56			80
40	20.0	4	64 (b)	11.73 (c)	20+++	80
44	40.0	8	100+	1.53 "	20+++	80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-40	0.002	5.72
	40-44	0.2	----

(a) AC Dust present on filter membranes.
(b) At 20 psi + 15 sec, Effluent Totamitor began to climb, and reached a peak value of 100+, 5 sec later. At which time the Effluent Totamitor was turned off.
(c) Qt. samples.

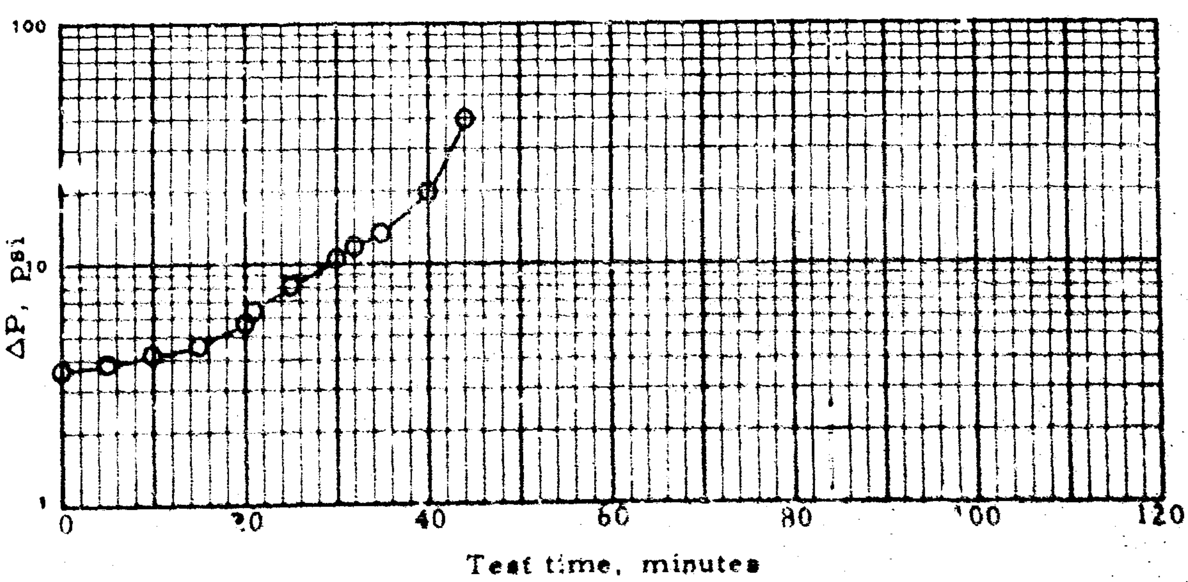


TABLE 140. SINGLE-ELEMENT LOOP TEST NO. 186 Date: 22 Jan 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 22 Jan 68
Anti-icing additive 0 vol.%, Dow, Lot
Corrosion inhibitor 0 lb/Mbbl,
Surfactant 0.02 mg/liter (0.007 lb/Mbbl) Petronate L (Witco), Lot 6S1079

Test duration, min	73	Calculated dirt loading, g	332
Fuel throughput, gal	1450	Actual element weight gain, g	339
Average rate, gpm	19.9		

Time	0 min	End test
Meter reading, gal	295	1745
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	*	*	91	99
IFT, distilled water, dyn/cm			41.5	39.4

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.6
pH	7.7
ST, dyn/cm	71.8

* Lost samples.

TABLE 140. SINGLE-ELEMENT LOOP TEST NO. 186 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.		Effluent, mg/liter Solids (a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.4	0	0				80
5	4.0	0	0		0.05	0-1	80
10	3.7	0	0				80
15	4.1	0	0				80
20	4.8	0	0				80
25	5.1	0	0				80
30	7.5	0	0				80
35	8.6	0	0				80
40	10.8	0	0				80
45	13.5	0	0				80
50	17.3	0	0				80
53	20.0	0	0	(b)	0.25	0-1	80
58	20.1	0	1		0.04	0-1	80
63	19.6	0	2			3-4	80
68	19.5	0	1			2-3	80
73	40.0	0	3		0.20	5-6	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-53	0.002	5.72
53-68	0.2	----
68-73	0.2	5.72

(a) Light AC Dust on test membranes.
(b) Peaking started at 20 psi + 25 sec, reached a peak value of 2.45 sec into interval. Interval for 2 min 30 sec. Effluent Totamitor started climbing again at 20 psi + 15 min 30 sec, peak value of 3 occurred at 4 min 30 sec into interval, 40 psi.

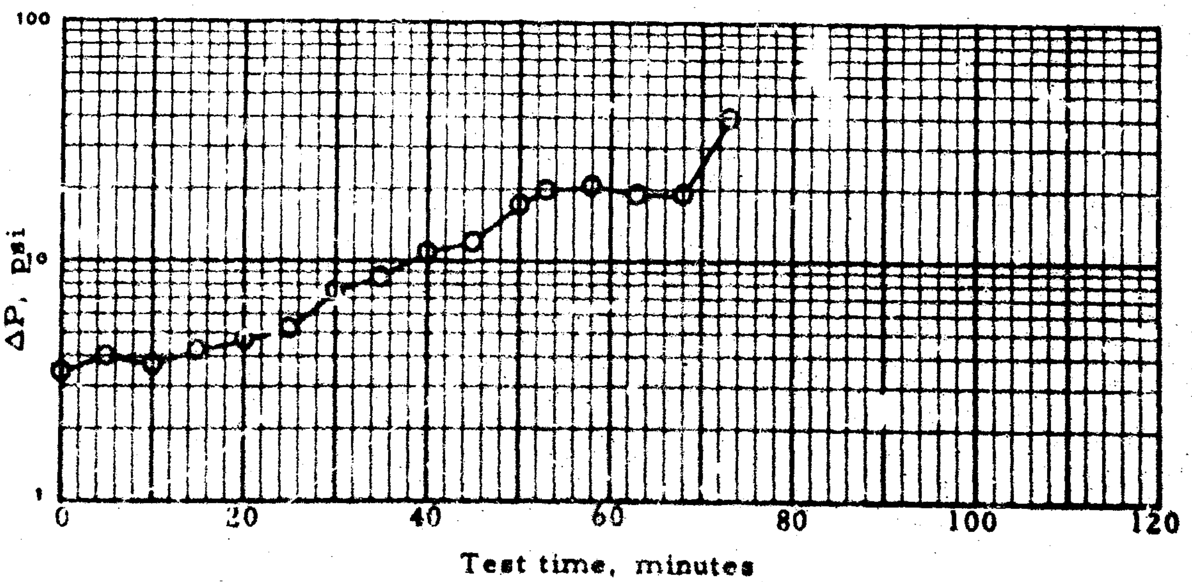


TABLE 141. SINGLE-ELEMENT LOOP TEST NO. 187 Date: 24 Jan 68

Loop no. 3(A1/SS)	Housing: 8" I.D. Aluminum
	Element: Filters Inc. I-4208 Lot 440-A
	Canister: DoD type 1

Procedure no. 13-A	Fuel flow, gpm	20
Water: Filtered tap water.	Fuel inlet temperature, °F	80
Solids: Coarse AC Dust.	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 23 Jan 68
Anti-icing additive 0 vol.%, Dow, Lot
Corrosion inhibitor 0 lb/Mbbl,
Surfactant 0.05 mg/liter (0.018 lb/Mbbl) Petronate L (Witco), Lot 6S1079

Test duration, min	65	Calculated dirt loading, g	286
Fuel throughput, gal	1313	Actual element weight gain, g	271*
Average rate, gpm	20.2		

Time	0 min	End test
Meter reading, gal	298	1611
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	90	79	82	96
IFT, distilled water, dyn/cm	43.6	42.4	44.3	43.6

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.7
ST, dyn/cm	72.4

* Lost dust.

TABLE 141. SINGLE-ELEMENT LOOP TEST NO. 187 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.5	0	0			80
5	3.6	0	0	0.23	0	82
10	4.0	0	1			80
15	4.8	0	1			80
20	7.1	0	1			80
25	9.5	0	1			80
30	12.5	0	1			80
35	16.6	0	5			80
37	20.0	0	5 (a)	5.61 (b)	20	80
40	17.2	0	14			80
42	18.2	0	13	0.58	20+	81
47	18.3	0	10		15-17	80
52	18.5	0	9		10-12	80
55	20.9	0	8			80
60	29.2	0	11			81
65	40.0	0	11	0.48	14-16	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-37	0.002	5.72
37-52	0.2	----
52-65	0.2	5.72

(a) Peaking started 20 psi + 15 sec, peak value of 71 at 15 sec into interval. Interval lasted 3 min 20 sec.
(b) AC Dust present on test filter membrane.

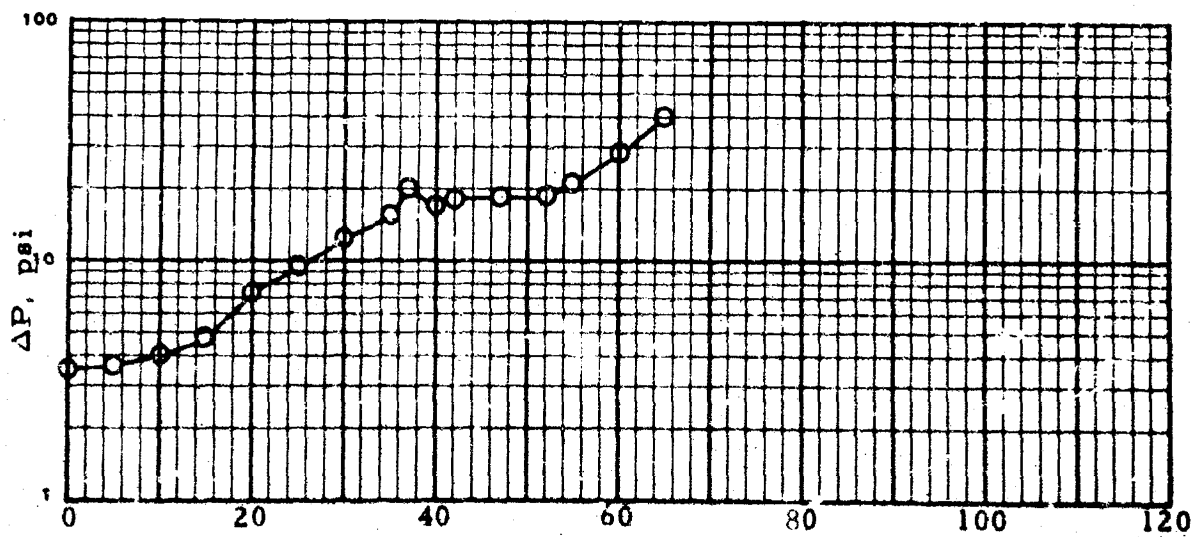


TABLE 142. SINGLE-ELEMENT LOOP TEST NO. 188 Date: 25 Jan 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 24 Jan 68
Anti-icing additive 0 vol.%, Dow, Lot
Corrosion inhibitor 0 lb/Mbbl,
Surfactant 0.05 mg/liter (0.018 lb/Mbbl) Petronate L (Witco), Lot 6S1079

Test duration, min	60	Calculated dirt loading, g	25/
Fuel throughput, gal	1190	Actual element weight gain, g	247
Average rate, gpm	19.8		

Time	0	End test
Meter reading, gal	301	1491
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	94	97	76	91
IFT, distilled water, dyn/cm	42.2	33.2	35.4	36.3

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.4
ST, dyn/cm	*

* Lost sample.

TABLE 142. SINGLE-ELEMENT LOOP TEST NO. 188 ,(Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids (a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.5	0	0			80
5	3.6	0	1	0.39	0	80
10	3.9	0	1			80
15	4.3	0	1			80
20	5.1	0	1			80
25	7.5	0	1			80
30	9.6	0	1			80
35	12.0	0	3			80
40	17.1	0	9			80
42	20.0	0	12 (b)	8.99 (c)	20+++	80
47	30.0	0	32	1.00	20+	[illegible]
52	31.4	0	13		12-14	80
57	33.3	0	13		10-12	80
60	40.0	0	16	0.53	20	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-42	0.002	5.72
42-57	0.2	----
57-60	0.2	5.72

(a) AC Dust present on filter membranes, except 5 min sample.

(b) At 20 psi + 15 sec, Effluent Totamitor began climbing. A peak value of 100+ was reached 15 sec into interval. Peaking lasted for 12 min 45 sec. At 14 min 45 sec after 20 psi, Effluent Totamitor began to climb. Reached a peak value of 16, 2 min 30 sec later, 40 psi.

(c) A sample of 2260 ml was filtered.

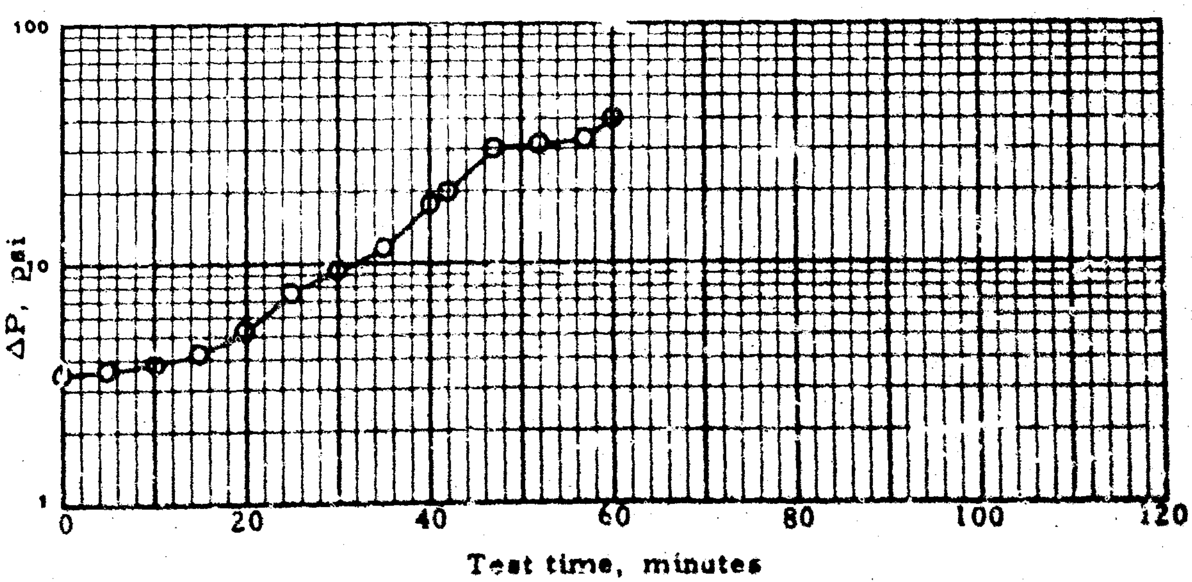


TABLE 143. SINGLE-ELEMENT LOOP TEST NO. 189 Date: 26 Jan 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 26 Jan 68
Anti-icing additive 0 vol. %, Dow, Lot
Corrosion inhibitor 0 lb/Mbbl,
Surfactant 0.02 mg/liter (0.007 lb/Mbbl) Petronate CR (Witco), Lot 6S1080

Test duration, min	60	Calculated dirt loading, g	257
Fuel throughput, gal	1196	Actual element weight gain, g	258
Average rate, gpm	19.9		

Time	0 min	End test
Meter reading, gal	293	1489
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	93	91	86	93
IFT, distilled water, dyn/cm	45.9	45.4	45.1	45.4

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.4
ST, dyn/cm	72.4

TABLE 143. SINGLE-ELEMENT LOOP TEST NO. 189 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.5	0	0			80
5	4.0	0	1	0.22	0	80
10	4.1	0	1			80
15	5.0	0	1			80
20	7.0	0	1			80
25	10.3	0	0			80
30	13.8	0	0			80
35	18.2	0	1			80
36	20.0	0	1 (a)	0.29	0-1	80
41	18.5	0	0	0.03	1-2	80
46	18.6	0	1		1-2	80
51	19.8	0	0		2-3	80
55	27.0	0	2			80
60	40.0	0	0	0.12	5-6	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-36	0.002	5.72
36-51	0.2	----
51-60	0.2	5.72

(a) Peaking started at 20 psi + 35 sec and lasted 2 min 25 sec. Peak value of 2 occurred at 2 min after 20 psi. 3 min 30 sec after 20 psi + 15 min peaking started; peak value of 3 occurred at 15 sec into interval. Peaking lasted 1 min 30 sec.

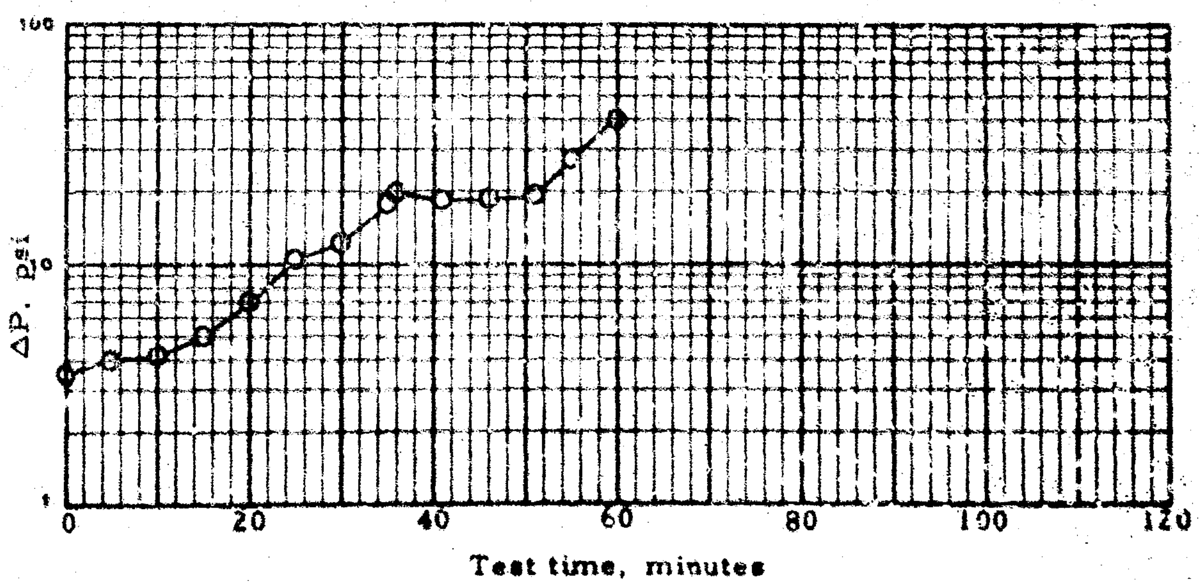


TABLE 144. SINGLE-ELEMENT LOOP TEST NO. 190 Date: 29 Jan 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 29 Jan 68
Anti-icing additive 0 vol. %, Dow, Lot
Corrosion inhibitor 0 lb/Mbbl,
Surfactant 0.05 mg/liter (0.018 lb/Mbbl) Petronate CR (Witco), Lot 6S1080

Test duration, min	65	Calculated dirt loading, g	286
Fuel throughput, gal	1301	Actual element weight gain, g	284**
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	3667	4968
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	97	92	94	*
IFT, distilled water, dyn/cm	*	*	38.9	39.6

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.6
ST, dyn/cm	71.6

* Lost samples.
** Lost dust.

TABLE 144. SINGLE-ELEMENT LOOP TEST NO. 190 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids (a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.5	0	0			80
5	3.6	0	1	0.25		80
10	4.0	0	1			80
15	4.8	0	1			80
20	6.4	0	1			80
25	8.5	0	1			80
30	11.5	0	1			80
35	15.4	0	1			80
39	20.0	0	1 (b)	0.15	2-3	80
44	16.3	0	1	0.15	3-4	81
49	16.4	0	0		3-4	81
54	16.6	0	0		2-3	81
55	20.3	0	0			81
60	28.5	0	0			81
65	40.0	0	1	0.03	8-9	81

Schedule:

Time, min	Water, gpm	Solids, g/min
0-39	0.002	5.72
39-54	0.2	----
54-65	0.2	5.72

(a) AC Dust on test membranes, also pinkish tint.
(b) Effluent Totamitor began to climb at 5 sec after 20 psi, and lasted 4 min. Peak value of 1 at 15 sec during interval of peaking.

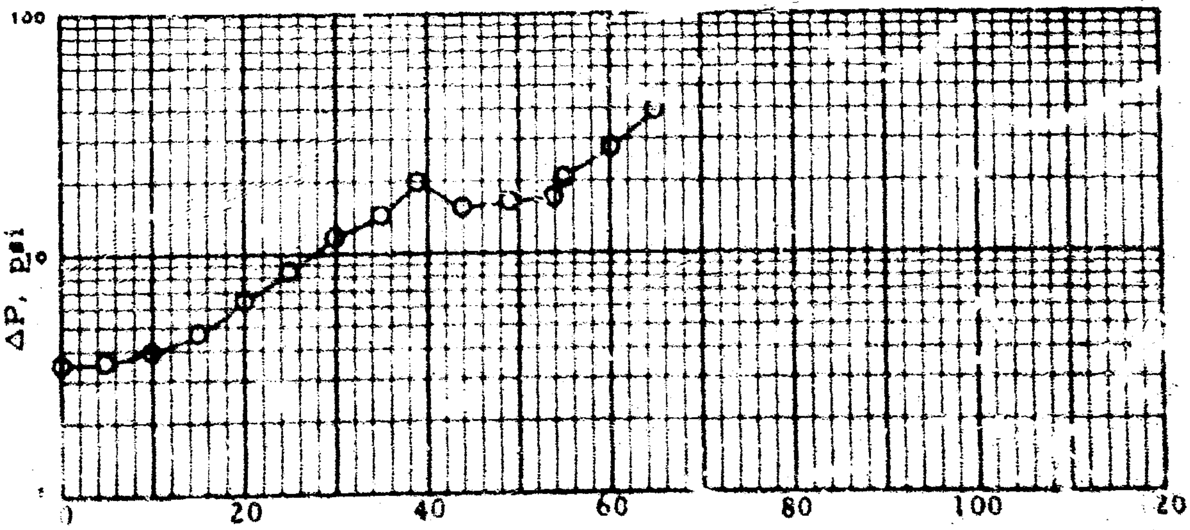


TABLE 145. SINGLE-ELEMENT LOOP TEST NO. 191 Date: 30 Jan 68

Loop no. 3(Al/SS)		Housing: 8" I.D. Aluminum	
		Element: Filters Inc. I-4208 Lot 440-A	
		Canister: DoD type 1	
Procedure no. 13-A		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80
Solids: Coarse AC Dust		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 29 Jan 68
Anti-icing additive 0 vol. %, Dow, Lot
Corrosion inhibitor 0 lb/Mbbl,
Surfactant 0.1 mg/liter (0.035 lb/Mbbl) Petronate CR (Witco), Lot 6S1080

Test duration, min	62	Calculated dirt loading, g	269
Fuel throughput gal	1236	Actual element weight gain, g	256
Average rate, gpm	19.9		

Time	0 min	End test
Meter reading, gal	300	1536
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	87*	34	94	91
IFT, distilled water, dyn/cm	45.9	41.6	43.1	43.6

Analyses on injection water:

Time	Post-test
Solids, mg/liter	1.1**
pH	7.7
ST, dyn/cm	71.4

* Fine disc did not meet spec.
** Particulate matter on test membrane.

TABLE 145. SINGLE-ELEMENT LOOP TEST NO. 191 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids (a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.5	0	0			80
5	4.0	0	0	0.13	0	80
10	4.0	0	0			80
15	4.6	0	0			80
20	7.0	0	0			80
25	8.8	0	0			80
30	12.0	0	0			80
35	17.3	0	0			80
38	20.0	0	0 (b)	0.14	0-1	80
43	18.9	0	1	0.15	3-4	80
48	19.3	0	1		1-2	81
53	19.1	0	1		2-3	81
55	24.3	0	1			81
60	34.3	0	0			81
62	40.0	0	0	0.09	2-3	81

Schedule:

Time, min	Water, gpm	Solids, g/min
0-38	0.002	5.72
38-53	0.2	----
53-62	0.2	5.72

(a) AC Dust on test membranes.

(b) Effluent Totamitor began to climb at 20 psi + 50 sec, and lasted 6 min. Peak value of 1 occurred at, 30 sec and 2 min 30 sec into interval.

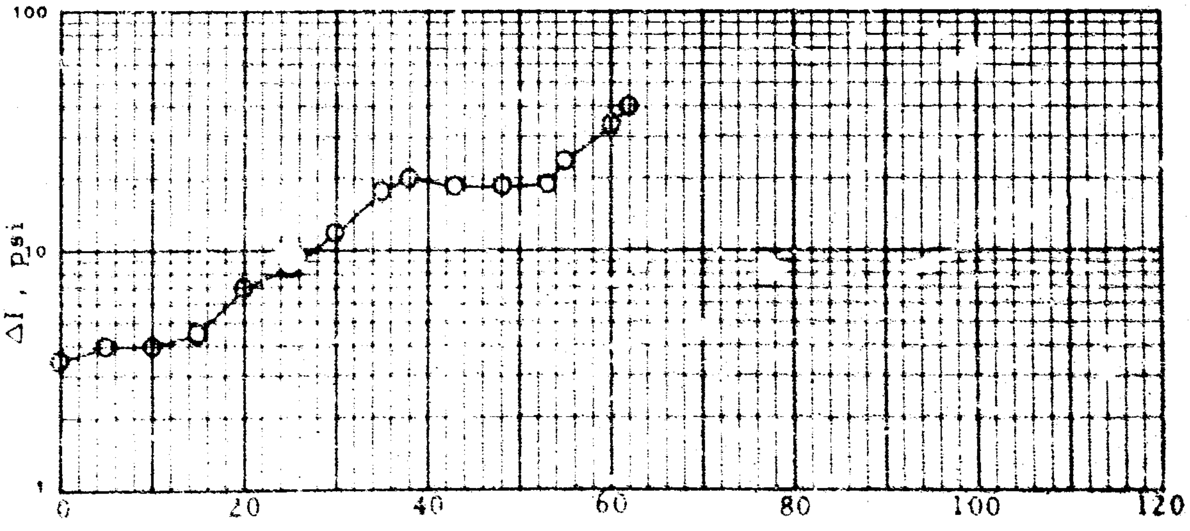


TABLE 146. SINGLE-ELEMENT LOOP TEST NO. 192 Date: 31 Jan 68

Loop no. 3(Al/SS)		Housing:	8" I.D. Aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no. 13-A		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80
Solids: Coarse AC Dust.		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 30 Jan 68
Anti-icing additive 0 vol. %, Dow, Lot
Corrosion inhibitor 0 lb/Mbbl,
Surfactant 0.2 mg/liter (0.07 lb/Mbbl) Petronate CR (Witco), Lot 6S1080

Test duration, min	55	Calculated dirt loading, g	229
Fuel throughput, gal	1108	Actual element weight gain, g	214
Average rate, gpm	20.1		

Time	0 min	End test
Meter reading, gal	297	1405
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	95	88	91	96
IFT, distilled water, dyn/cm	44.1	44.2	36.5	36.1

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.3
ST, dyn/cm	73.4

TABLE 146. SINGLE-ELEMENT LOOP TEST NO. 192 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.3	0	0			80
5	4.6	0	1	0.29	0	80
10	5.7	0	1			80
15	9.8	0	1			80
20	13.5	0	1			80
25	20.0	0	0 (a)	0.16	0-1	80
30	14.2	0	2	0.08	3-4	80
35	14.8	0	3		4-5	80
40	15.0	0	4		9-10	80
45	21.3	0	1			80
50	29.2	0	1			80
55	40.0	0	1	neg.	3-4	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-25	0.002	5.72
25-40	0.2	----
40-55	0.2	5.72

(a) Effluent Totamitor began to climb at 20 psi + 20 sec; reached a peak value of 7, 40 sec later. Total time was 2 min 10 sec. Another peak value, of 10, occurred at 12 min 50 sec after 20 psi. Total time, 1 min 40 sec.

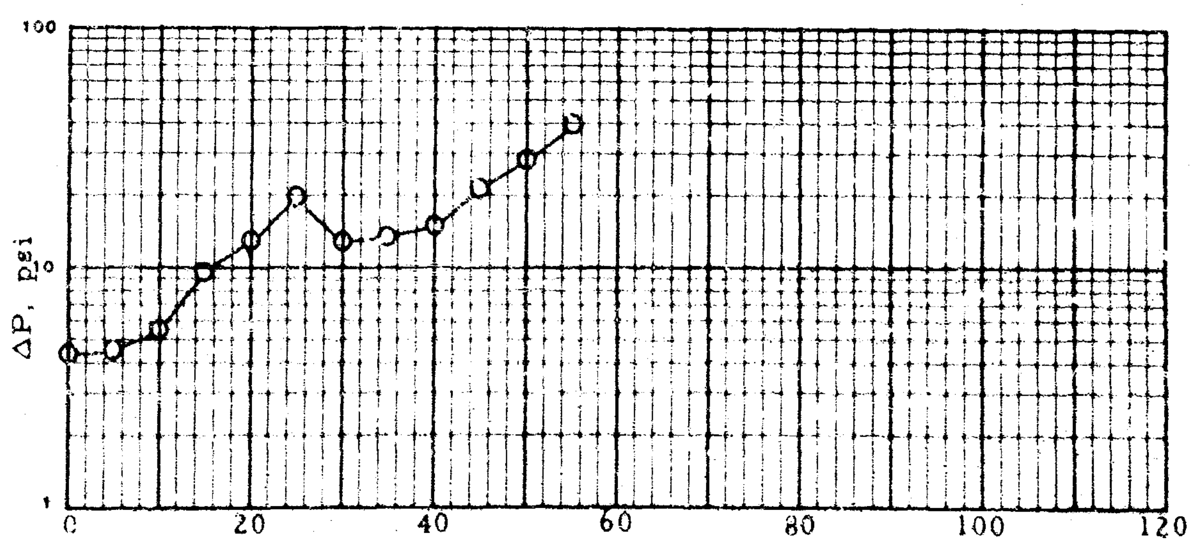


TABLE 147. SINGLE-ELEMENT LOOP TEST NO. 193 Date: 2 Feb 68

Loop no. 3(Al/SS)

Housing: [illegible]" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 31 Jan 68
Anti-icing additive 0 vol. %, Dow, Lot
Surfactant 0.25 mg/L (0.088 lb/Mbbl) Petronate CR (Witco) , Lot 6S108C

Test duration, min	91	Calculated dirt loading, g	435
Fuel throughput, gal	1813	Actual element weight gain, g	337*
Average rate, gpm	19.9		

Time	0 min	End test
Meter reading, gal	300	2113
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	58	74	63	97
IFT, distilled water, dyn/cm	41.6	36.9	42.0	40.0

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.4
ST, dyn/cm	71.9

* Discrepancy caused by low delivery of dirt feeder.

TABLE 147. SINGLE-ELEMENT LOOP TEST NO. 193 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.3	0	0			80
5	3.5	0	1	0.32	0	80
10	3.8	0	2			80
15	4.4	0	2			80
20	5.6	0	2			80
25	7.5	0	2			80
30	9.8	0	1			80
35	12.3	0	1			80
40	16.0	0	1			80
44	20.0	0	1 (a)	0.71	0-1	80
49	17.5	0	1	0.08	0-1	80
54	18.0	0	1		0-1	80
59	18.0	0	1		0-1	80
60	18.4	0	1			80
65	22.0	0	0			80
70	25.3	0	0			80
75	28.6	0	1			80
80	32.1	0	1			80
85	35.0	0	6			80
91	40.0	0	1	0.06	0-1	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-44	0.002	5.72
44-59	0.2	----
59-91	0.2	5.72

(a) Initial time of peak started at 20 psi + 15 sec, and lasted for a period of 75 sec. A peak value of 4 occurred at 20 psi + 30 sec. Initial time of peak started at 20 psi + 36 min, and lasted for a period of 8 min. A peak value of 8 occurred at 20 psi + 37 min.

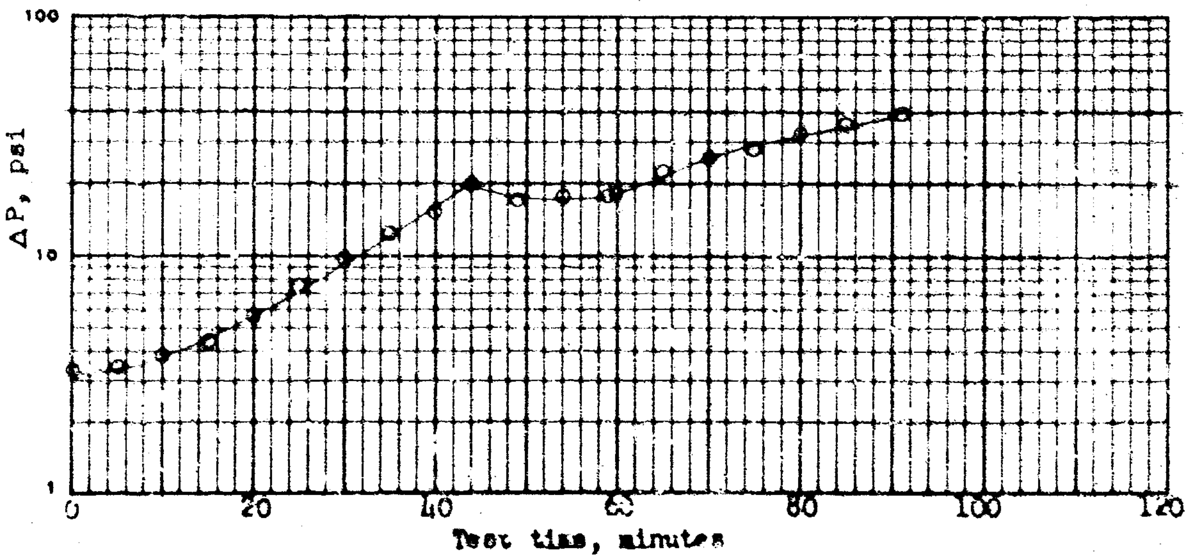


TABLE 148. SINGLE-ELEMENT LOOP TEST NO. 194 Date: 5 Feb 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 5 Feb 68
Anti-icing additive 0 vol.%. Dow, Lot
Surfactant 1.0 mg/L (0.35 lb/Mbbl) Petronate CR (Witco) , Lot 6S1080

Test duration, min	38
Fuel throughput, gal	765
Average rate, gpm	20.1

Calculated dirt loading, g	149
Actual element weight gain, g	140

Time	0 min	End test
Meter reading, gal	305	1070
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	99	79	68	63
IFT, distilled water, dyn/cm	45.5	45.5	44.6	45.3

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.4
ST, dyn/cm	73.4

TABLE 148. SINGLE-ELEMENT LOOP TEST NO. 194 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids (a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.0	0	0			
5	4.0	0	1	0.30	0-1	80
10	4.7	0	1			80
15	6.5	0	2			80
20	10.9	0	2			80
25	17.5	0	4			80
26	20.0	1	5 (b)	8.71	4-5	80
31	32.5	2	48	1.41 (c)	20+	80
36	38.5	2	45		20+	80
38	40.0	2	47	0.63 "	20+	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-26	0.012	5.72
26-38	0.2	----

(a) AC Dust present on test membranes.
(b) Initial time of peak started at 20 psi, and lasted for a period of 11.2 min. A peak value of 66 occurred at 27 min.
(c) Qt samples.

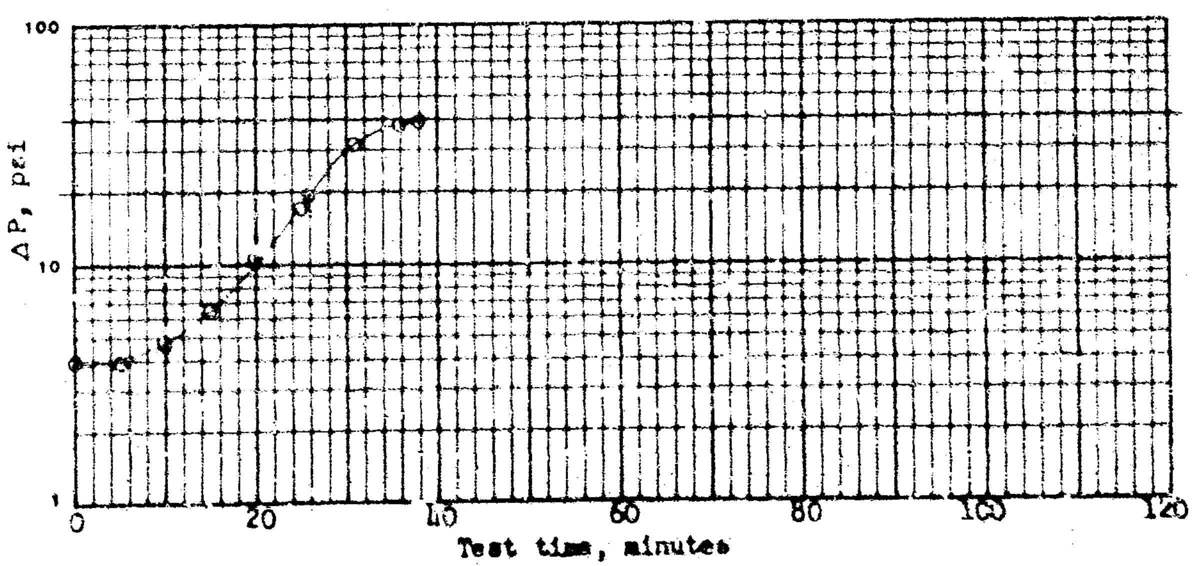


TABLE 149. SINGLE-ELEMENT LOOP TEST NO. 195 Date: 6 Feb 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 6 Feb 68
Anti-icing additive 0 vol. %, Dow, Lot
Surfactant 0.25 mg/L (0.088 lb/Mbbl) Petronate CR (Witco), Lot 681080

Test duration, min	66
Fuel throughput, gal	1313
Average rate, gpm	19.9

Calculated dirt loading, g	292
Actual element weight gain, g	258

Time	0 min	End test
Meter reading, gal	8647	9960
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	81	81	81	92
IFT, distilled water, dyn/cm	45.7	43.9	45.9	46.0

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.4
ST, dyn/cm	73.5

TABLE 149. SINGLE-ELEMENT LOOP TEST NO. 195 (Cont'd)

Time, min	ΔP, psi	Totamitor		Effluent, mg/liter		Influent fuel temperature, °F
		Infl.	Effl.	Solids	Free water	
0	3.5	0	0			
5	3.8	0	2	0.46	0	8
10	4.2	0	2			80
15	4.9	0	2			80
20	6.4	0	2			80
25	9.2	0	2			80
30	14.0	0	2			80
34	20.0	0	2 (a)	0.87 (b)	0	80
39	18.5	0	1	0.10	0-1	30
44	18.0	0	1		0-1	80
49	19.4	0	1		0-1	80
54	23.1	0	1			80
59	30.0	0	1			80
64	37.6	0	1			80
66	40.0	0	1	0.06	0-1	80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-34	0.002	5.72
	34-49	0.2	----
	49-66	0.2	5.72

(a) Initial time of peak started at 20 psi + 25 sec. and lasted for a period of 2 min 5 sec. A peak value of 6 occurred at 20 psi + 50 sec.
(b) AC Dust present on test membrane.

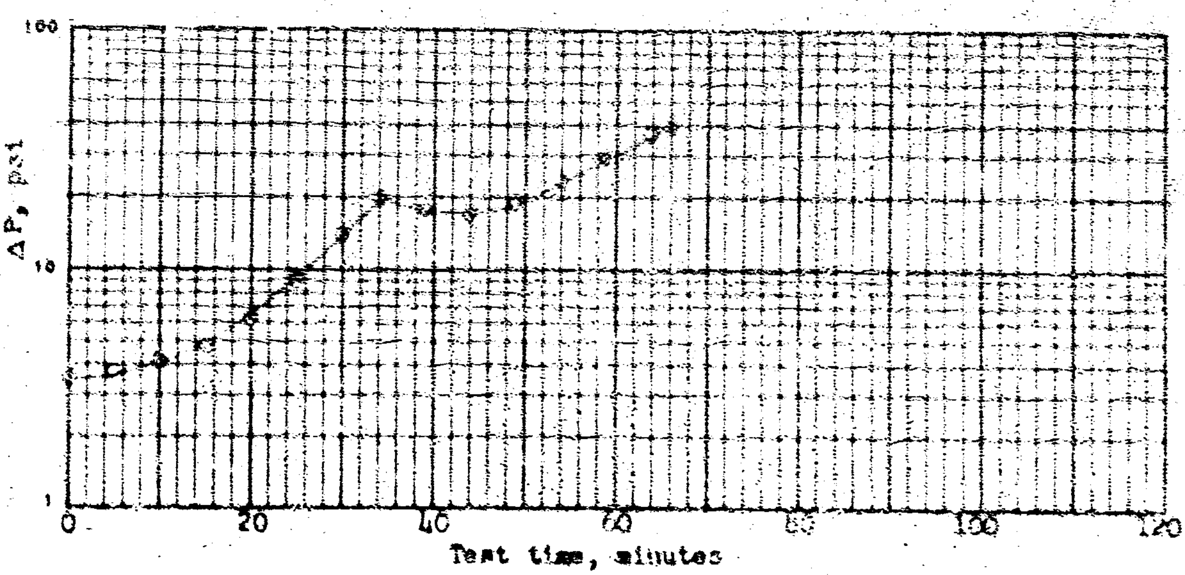


TABLE 150. SINGLE-ELEMENT LOOP TEST NO. 196 Date: 7 Feb 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 6 Feb 68
Anti-icing additive 0 vol. %, Dow, Lot
Surfactant 0.5 mg/L (0.175 lb/Mbbl) Petronate CR (Witco), Lot 6S1080

Test duration, min	48	Calculated dirt loading, g	189
Fuel throughput, gal	977	Actual element weight gain, g	187
Average rate, gpm	20.4		

Time	0 min	End test
Meter reading, gal	301	1278
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	81	65	63	81
IFT, distilled water, dyn/cm	45.9	44.4	44.0	43.7

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.4
ST, dyn/cm	72.8

TABLE 150. SINGLE-ELEMENT LOOP TEST NO. 196 (Cont'd)

Time, min	ΔP, psi	Totamiter Infl.	Totamiter Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.9	0	0			
5	4.2	0	2	0.46	0	80
10	4.9	0	2			80
15	7.5	0	2			80
20	11.7	0	2			80
25	17.2	0	2			80
27	20.0	0	2 (a)	2.25 (b)	0-1	80
32	21.2	1	7	0.65	4-5	81
37	23.5	1	9		6-7	81
42	25.6	1	9		8-10	81
47	37.0	0	11			81
48	40.0	0	11	0.59	10-12	81

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-27	0.002	5.72
	27-42	0.2	----
	42-48	0.2	5.72

(a) Initial time of peak started at 20 psi + 20 sec, and lasted for a period of 2 min 25 sec. A peak value of 12 occurred at 20 psi + 50 sec. Initial time of peak started at 20 psi + 7 min 55 sec, and lasted for a period of 65 sec. A peak value of 13 occurred at 20 psi + 8 min 10 sec.
(b) AC Dust present on test membrane.

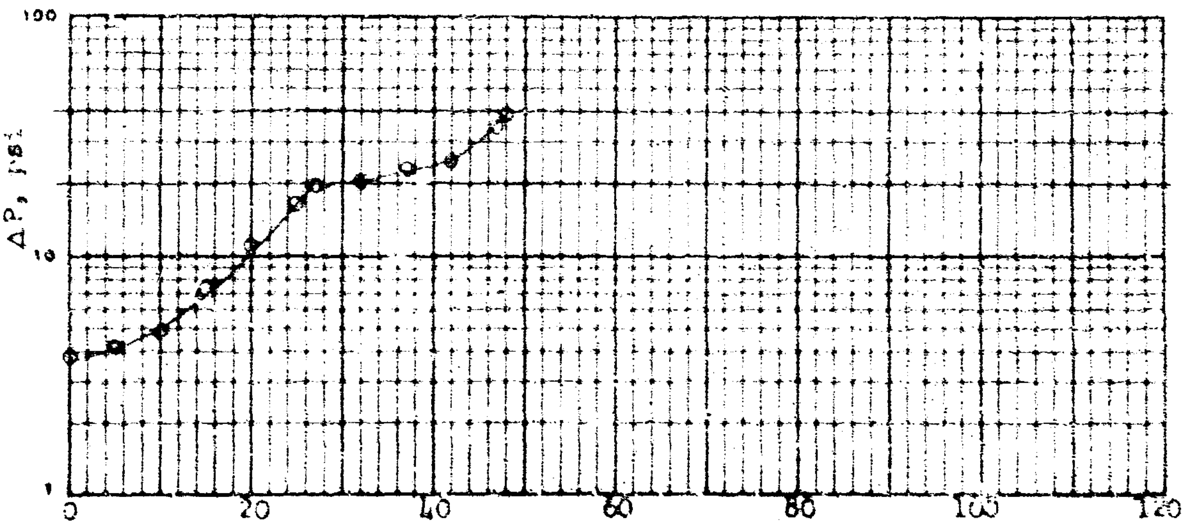


TABLE 151. SINGLE-ELEMENT LOOP TEST NO. 197 Date: 8 Feb 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 8 Feb 68
Anti-icing additive 0 vol. %, Dow, Lot
Surfactant 1.0 mg/L (0.35 lb/Mbbl). Sodium Naphthenate N-C-2 (lab prepn.)

Test duration, min	64
Fuel throughput, gal	1283
Average rate, gpm	20.0

Calculated dirt loading, g	280
Actual element weight gain, g	265*

Time	0 min	End test
Meter reading, gal	300	1583
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	83 (81)**	94	87	90
IFT, distilled water, dyn/cm	40.8 (41.0)**	41.5	41.2	44.3

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.6
ST, dyn/cm	72.1

* Lost AC Dust.
** Incoming fuel sample, before filling tank.

TABLE 151. SINGLE-ELEMENT LOOP TEST NO. 197 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.0	0	0			
5	4.4	0	0	0.1	0	80
10	4.9	0	1			80
15	6.4	0	1			80
20	10.5	0	1			80
25	16.5	0	1			80
27	20.0	0	1 (a)	0.54 (b)	0	80
32	18.5	0	0	neg.	0-1	80
37	19.2	0	0		0-1	80
42	19.4	0	0		0-1	80
47	24.4	0	0			80
52	27.8	0	0			80
55	30.5	0	6	0.00 (b),(c)	4-5	80
57	31.4	0	5			80
62	37.5	0	0			80
64	40.0	0	0	neg.	1-2	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-27	0.002	5.72
27-42	0.2	----
42-64	0.2	5.72

(a) Initial time of peak started at 20 psi + 27 min, and lasted for a period of 3 min 30 sec. A peak value of 7 occurred at 20 psi + 27 min 45 sec.
(b) AC Dust present on test membrane.
(c) Special sample.

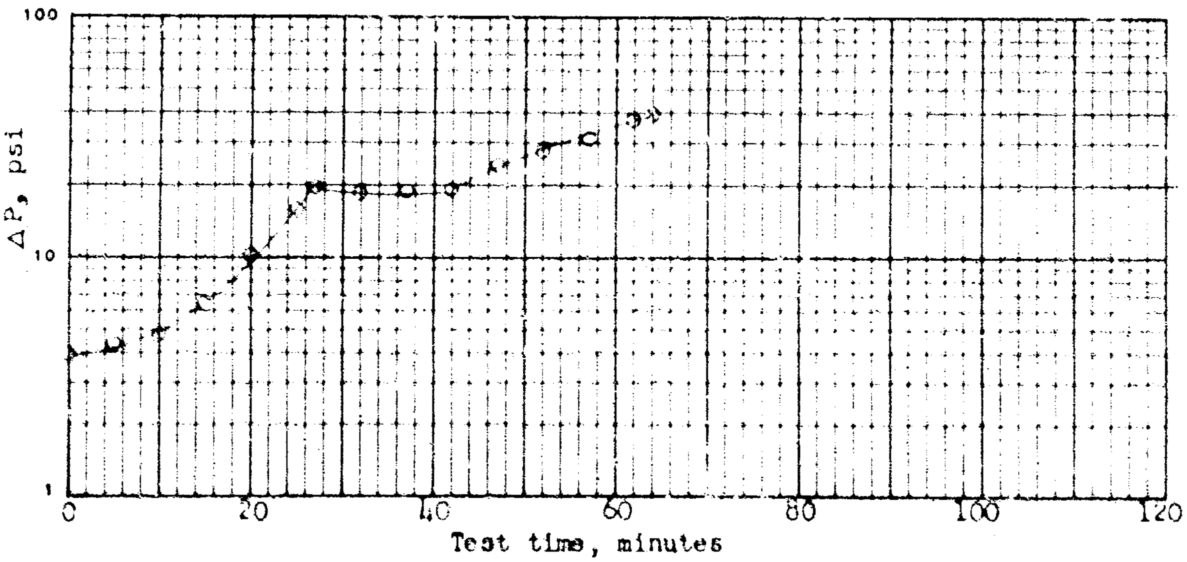


TABLE 152. SINGLE-ELEMENT LOOP TEST NO. 198 Date: 9 Feb 68

Loop no.	3(Al/SS)	Housing:	8" I.D. Aluminum
		Element:	Filters Inc. I-4208 Lot 440-A
		Canister:	DoD type 1

Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water.	Fuel inlet temperature, °F	80
Solids:	Coarse AC Dust.	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 9 Feb 68
Anti-icing additive 0 vol. %, Dow, Lot
Surfactant 10 mg/L (3.5 lb/Mbbl) Sodium Naphthenate N-C-2 (lab prepn.)

Test duration, min	62	Calculated dirt loading, g	269
Fuel throughput, gal	1231	Actual element weight gain, g	262
Average rate, gpm	19.8		

Time	0 min	End test
Meter reading, gal	298	1529
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	94	79*	75*	85
IFT, distilled water, dyn/cm	43.5	41.5	42.8	42.3

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.3
pH	7.5
ST, dyn/cm	72.6

* Meter not holding steady.

TABLE 152. SINGLE-ELEMENT LOOP TEST NO. 198 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.5	0	0			
5	3.6	0	0	0.22	0	80
10	4.1	0	1			80
15	5.0	0	2			80
20	7.7	0	5			80
25	11.4	0	3			80
30	16.6	0	3			80
33	20.0	0	2 (a)	1.28 (b)	0	80
38	19.4	0	0	0.10 (b)	0-1	80
43	20.0	0	0		1-2	80
48	19.9	0	0		3-4	80
50	23.9	0	0			80
53	26.1	0	0			80
55	28.6	0	0			80
60	36.9	0	1			80
62	40.0	0	1	0.07 (b)	5-6	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-33	0.002	5.72
33-48	0.2	----
48-62	0.2	5.72

(a) Initial time of peak started at 20 psi + 25 sec, and lasted for a period of 2 min 25 sec. A peak value of 10 occurred at 20 psi + 35 sec.
(b) Visible AC Dust present on test membrane.

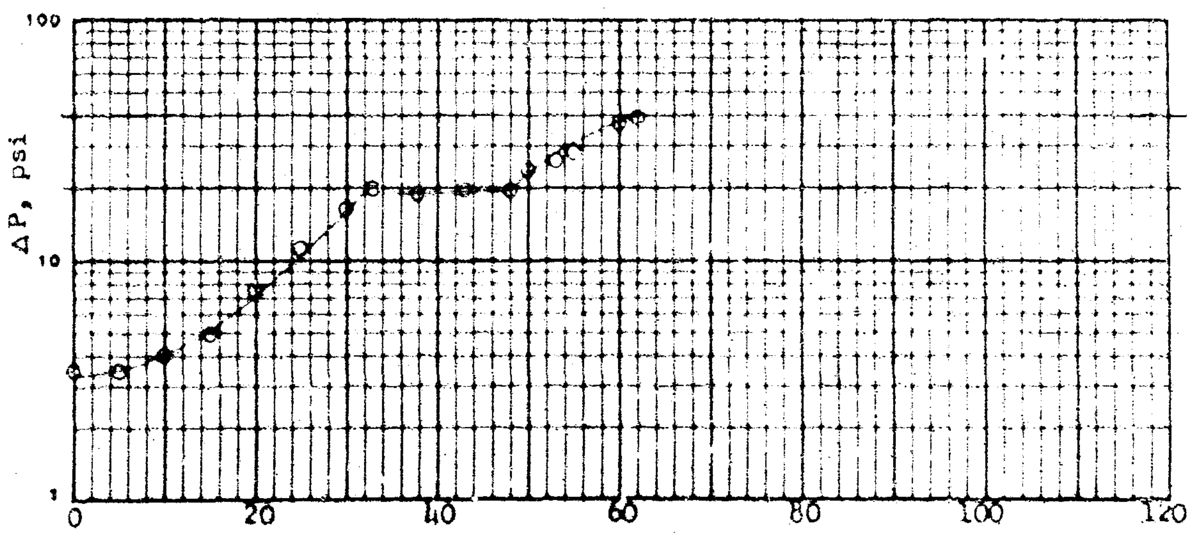


TABLE 153. SINGLE-ELEMENT LOOP TEST NO. 199 Date: 12 Feb 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 440-A
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 21 , fresh
Date blended with additives: 12 Feb 68
Anti-icing additive 0 vol. %, Dow, Lot
Surfactant 50 mg/L (17.5 lb/Mbbl) Sodium Naphthenate N-C-2 (lab prepn.)

Test duration, min	49	Calculated dirt loading, g	194
Fuel throughput, gal	975	Actual element weight gain, g	193
Average rate, gpm	19.9		

Time	0 min	test
Meter reading, gal	300	1275
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	94 (77)*	43	72	46
IFT, distilled water, dyn/cm	39.6 (41.0)*	40.[illegible]	36.7	38.0

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.6
ST, dyn/cm	73.8

* Incoming fuel sample, before filling tank.

TABLE 153. SINGLE-ELEMENT LOOP TEST NO. 199 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.7	0	0			
5	3.8	0	0	0.08	0	80
10	4.5	0	3 (a)			80
15	6.0	0	6			80
20	9.6	1	7	2.30 (b),(c)	0	80
25	15.0	1	7			80
29	20.0	2	5 (d)	2.41 (b)	0	80
34	22.0	2	0		0-1	80
39	22.2	2	0		1-2	80
44	22.6	2	0		0-1	80
45	26.0	2	1			80
48	38.8	1	1			80
49	40.0	1	1	0.15	1-2	80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-29	0.002	5.72
	29-44	0.2	----
	44-49	0.2	5.72

(a) Initial time of peak started at 8 min 15 sec into test, and lasted for a period of 16 min 15 sec. A peak value of 10 occurred at 23 min 30 sec.
(b) AC Dust present on test membranes.
(c) Special sample.
(d) Initial time of peak started at 20 psi + 15 sec, and lasted for a period of 3 min. A peak value of 27 occurred at 20 psi + 25 sec.

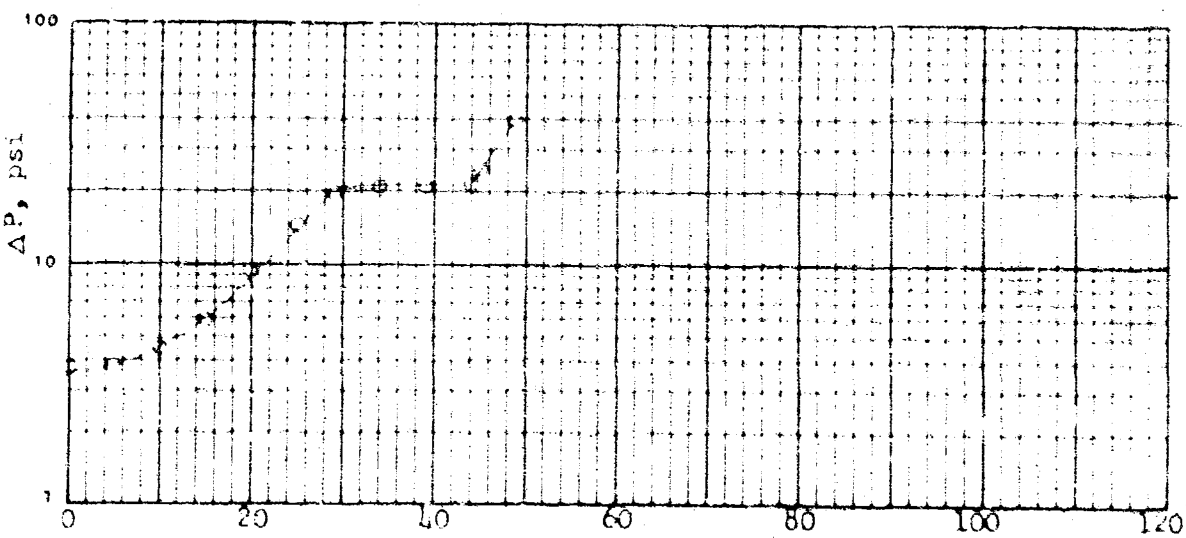


TABLE 154. SINGLE-ELEMENT LOOP TEST NO. 200 Date: 20 Feb 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 22 , fresh
Date blended with additives: 20 Feb 68
Anti-icing additive 0 vol. %, Dow, Lot
Surfactant 10 mg/L (3.5 lb/Mbbl) Sodium Naphthenate N-A-1 (lab prepn.)

Test duration, min	36	Calculated dirt loading, g	120
Fuel throughput, gal	723	Actual element weight gain, g	126
Average rate, gpm	20.1		

Time	0 min	End test
Meter reading, gal	302	1025
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	100*	82**	100*	81**
IFT, distilled water, dyn/cm	37.4	41.2	42.6	43.4

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.5
ST, dyn/cm	71.5

* Amount of water injected is questionable, values not valid. Samples analyzed on instrument B.
** Samples analyzed on instrument A.

TABLE 154. SINGLE-ELEMENT LOOP TEST NO. 200 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.4	0	0	neg. (a)	-	80
5	3.5	0	1	0.15	0	80
10	5.5	0	2			80
15	19.0	0	6			80
15	20.0	0	6 (b)	4.16 (c)	0	80
20	27.5	0	1	0.05	0-1	80
25	28.3	0	1		1-2	80
30	29.0	0	1		1-2	80
35	38.5	0	22			80
36	40.0	0	12	0.05	19-20	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-15	0.002	5.72
15-30	0.2	----
30-36	0.2	5.72

(a) Incoming solid sample, unin., before filling tank.
(b) Initial time of peak started at 20 psi + 5 sec, and lasted for a period of 3 min 30 sec. A peak value of 30 occurred at 20 psi + 35 sec. Initial time of peak started at 20 psi + 18 min 45 sec, and lasted for a period of 4 min. A peak value of 22 occurred at 20 psi + 21 min 30 sec.
(c) AC Dust present on test membrane.

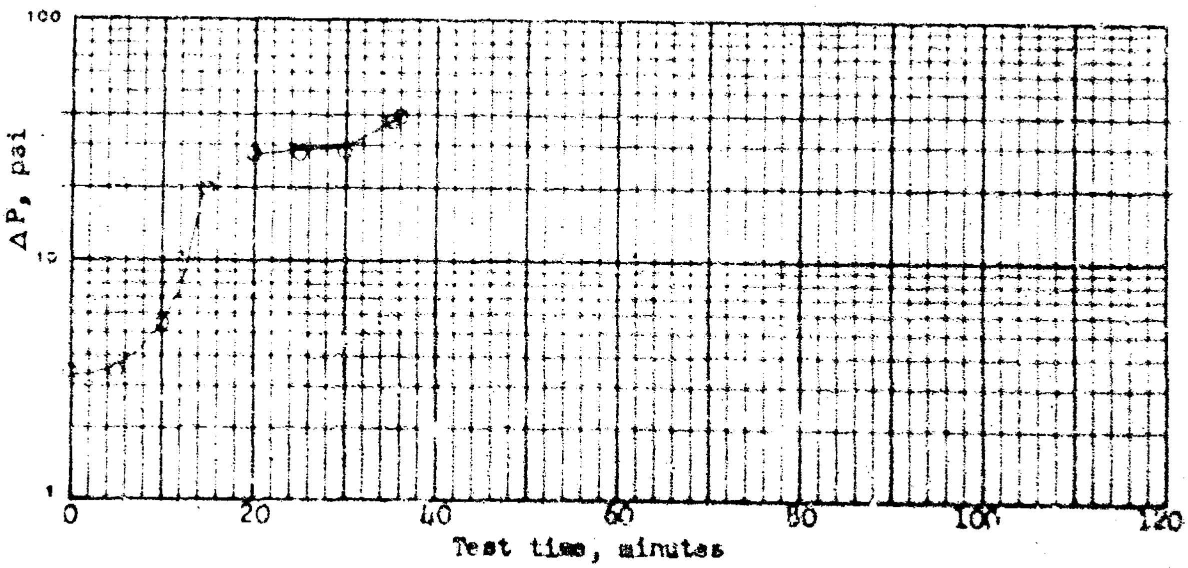


TABLE 155. SINGLE-ELEMENT LOOP TEST NO. 201 Date: 21 Feb 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 22 , fresh
Date blended with additives: 20 Feb 68
Anti-icing additive 0 vol.%, Dow, Lot
Surfactant 1.0 mg/L (0.35 lb/Mbbl) Sodium Naphthenate N-A-1 (lab prepn.)

Test duration, min	45
Fuel throughput, gal	903
Average rate, gpm	20.1

Calculated dirt loading, g	172
Actual element weight gain, g	178

Time	0 min	End test
Meter reading, gal	300	1203
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-tes
WSIM, distilled water	93 (93)*	90 (89)*	89 (89)*	92 (87
IFT, distilled water, dyn/cm	43.7	42.9	44.7	44.2

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.6
ST, dyn/cm	72.6

* Corresponding samples analyzed on instrument B. This was done to check instrument A. Samples were taken at same position and approximately same time.

TABLE 155. SINGLE-ELEMENT LOOP TEST NO. 201 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.3	0	0			
5	3.4	0	0	0.12 (a)	0	80
10	3.5	0	0 (b)			80
15	4.5	0	1			80
20	9.8	0	2			80
23	20.0	0	8	3.51 (c)	0	80
28	24.0	0	0	0.03	0-1	80
33	24.6	0	0		0-1	80
38	25.2	0	0		2-3	80
40	32.0	0	0			80
45	40.0	0	0	0.84 (a)	2-3	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-23	0.002	5.72
23-38	0.2	----
38-45	0.2	5.72

(a) Deposits on test membranes observed under microscope to be stainless steel filings.
(b) Initial time of peak started at 10 min into test, and lasted for a period of 16 min. A peak value of 25 occurred at 23 min 40 sec or 20 psi + 40 sec.
(c) AC Dust present on test membrane.

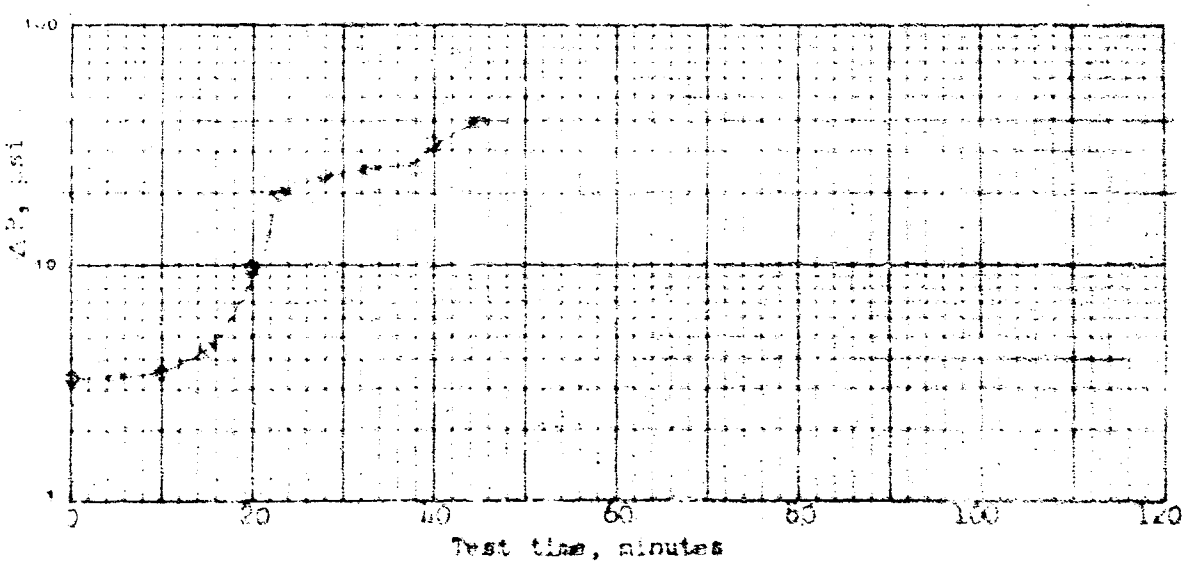


TABLE 156. SINGLE-ELEMENT LOOP TEST NO. 202 Date: 23 Feb 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 22 , fresh
Date blended with additives: 23 Feb 68
Anti-icing additive 0 vol. %, Dow, Lot
Surfactant 5.0 mg/L (1.75 lb/Mbbl) Sodium Naphthenate N-A-1 (lab prepn.)

Test duration, min	44
Fuel throughput, gal	886
Average rate, gpm	20.1

Calculated dirt loading, g	166
Actual element weight gain, g	176

Time	0 min	End test
Meter reading, gal	300	1186
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Unin.	After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	91*	73*	65*	87**
IFT, distilled water, dyn/cm	43.9	42.4	41.1	39.9

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.3
pH	7.7
ST, dyn/cm	72.2

* Samples analyzed on instrument B.
** Sample analyzed on instrument A.

TABLE 156. SINGLE-ELEMENT LOOP TEST NO. 202 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.5	0	0			80
5	3.6	0	0	0.23 (a)	0	80
10	3.9	0	1 (b)			80
15	5.2	0	1			80
20	17.5	0	5			80
21	20.0	0	5	2.26 (c)	0	80
26	28.0	0	0	0.02 (d)	0-1	80
31	28.2	0	40		20+	80
36	29.0	0	44		20+	80
40	36.4	0	15			80
44	40.0	0	1	neg. (d)	2-3	80

Schedule:

Time, min	Water, gpm	Solids, g/min
0-21	0.002	5.72
21-36	0.2	----
36-44	0.2	5.72

(a) Particulate matter present on test membrane.
(b) Initial time of peak started at 9 min into test, and lasted for a period of 14 min 10 sec. A peak value of 20 occurred at 20 psi + 55 sec. Initial time of peak started at 20 psi + 6 min 45 sec, and lasted for a period of 15 min 45 sec. A peak value of 49 occurred at 20 psi + 16 min 30 sec.
(c) AC Dust present on test membrane.
(d) Pink tint present on test membranes.

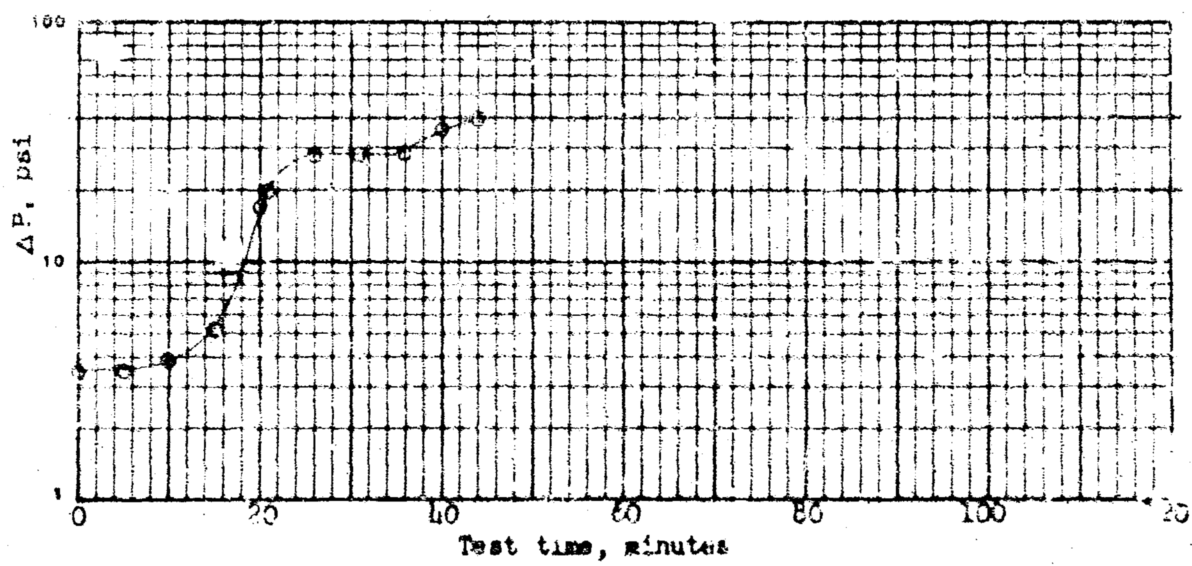


TABLE 157. SINGLE-ELEMENT LOOP TEST NO. 203 Date: 26 Feb 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DcD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 22 , fresh
Date blended with additives: 26 Feb 68
Anti-icing additive 0 vol. %, Dow, Lot
Surfactant 0.5 mg/L (0.175 lb/Mbbl) Sodium Naphthenate N-A-1 (lab prepn.)

Test duration, min	58
Fuel throughput, gal	1148
Average rate, gpm	19.8

Calculated dirt loading, g	246
Actual element weight gain, g	253

Time	0 min	End test
Meter reading, gal	300	1448
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Unin.		After Add. Inj.	Pre-test	Post-test
WSIM, distilled water	88*	(83)**	84*	74*	93***
IFT, distilled water, dyn/cm	39.0	(39.2)**	42.6	39.9	39.1

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.5
ST, dyn/cm	72.8

* Samples analyzed on instrument B.
** Incoming fuel sample, unin., before filling tank. WSIM sample analyzed on instrument B.
*** Sample analyzed on instrument A.

TABLE 157. SINGLE-ELEMENT LOOP TEST NO. 203 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.0	0	0			79
5	4.0	0	0	0.11 (a)	0	80
10	4.1	0	0			80
15	4.5	0	0			80
20	5.4	0	0			80
25	10.6	0	1 (b)			80
29	20.0	0	2	1.24 (c)	0	80
34	24.0	0	0	0.04 (a)	0-1	80
39	24.5	0	0		1-2	80
44	25.5	0	0		0-1	80
45	27.9	0	0			80
50	32.6	0	0			80
55	37.7	0	0			80
58	40.0	0	0	neg. (a)	8-10	80

Schedule:	Time, min	Water, gpm	Solids, g/min
	0-29	0.002	5.72
	29-44	0.2	----
	44-58	0.2	5.72

(a) Pink tint present on test membranes.
(b) Initial time of peak started at 23 min into test, and lasted for a period of 2 min 10 sec. A peak value of 11 occurred at 29 min 30 sec or 20 psi + 30 sec.
(c) AC Dust present on test membrane.

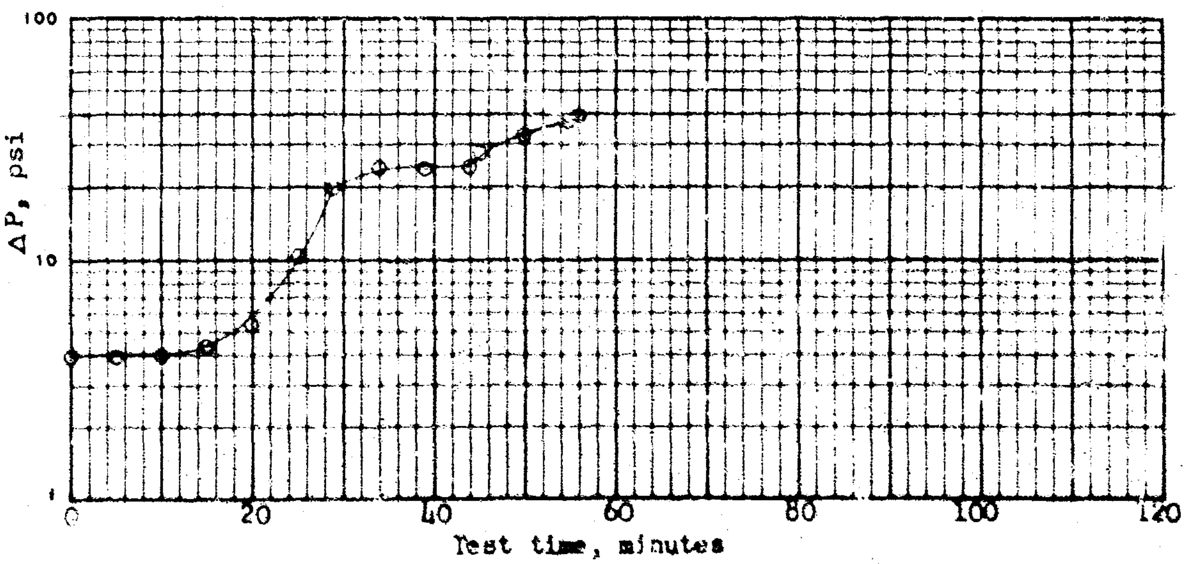


TABLE 158. SINGLE-ELEMENT LOOP TEST NO. 203A Date: 22 April 68

Loop no. 3(Al/SS)		Housing:	8" I.D. Aluminum
		Element:	Filters Inc. I-4208 Lot 465
		Canister:	DoD type 1
Procedure no. Special[(a)]		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80 [(b)]
Solids: None		Fuel inlet pressure, psi	70

Water injection schedule: 0.2 gpm from 0 min to 60 min, then discontinued.

Solids injection schedule: No Solids

Test fuel JP-5 batch no. 22 , fresh
Date blended with additives: None
Anti-icing additive None vol. %, Dow, Lot
Corrosion inhibitor None lb/Mbbl, , Lot

Test duration, min	120	Calculated dirt loading, g	
Fuel throughput, gal	2400	Actual element weight gain, g	
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	104	2504
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel: None
- Time
- WSIM, distilled water
- IFT, distilled water, dyn/cm

Analyses on injection water: None
- Time
- Solids, mg/liter
- pH
- ST, dyn/cm

(a) Run made merely to expose element to fuel and water, for subsequent dryout and retest.

(b) Temperature indicator about 5°F in error; actual temperature of run 75°F.

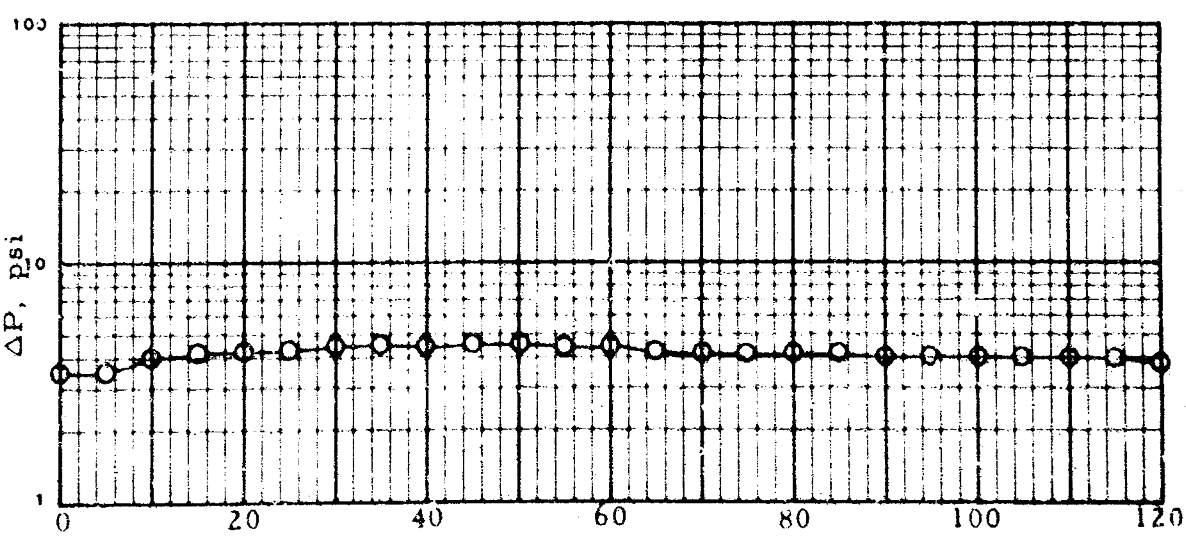
TABLE 158. SINGLE-ELEMENT LOOP TEST NO. 203A (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water (a)	Influent fuel temperature, °F
0	3.5	0	0	None		79
5	3.5	0	0			79
10	4.0	0	0			80
15	4.1	0	0		0-1 (1-2)	80
20	4.2	0	0			80
25	4.3	0	0			80
30	4.5	0	0		0-1 (1-2)	80
35	4.5	0	0			80
40	4.5	0	0			80
45	4.6	0	0		0-1 (2-3)	80
50	4.6	0	0			80
55	4.5	0	0			80
60	4.5	0	0		0-1 (1-2)	80
65	4.2	0	0			80
70	4.1	0	0			80
75	4.1	0	0			80
80	4.1	0	0			80
85	4.1	0	0			80
90	4.0	0	0		0-1 (0-1)	80
95	4.0	0	0			80
100	4.0	0	0			80
105	4.0	0	0			80
110	4.0	0	0			80
115	4.0	0	0			80
120	3.9	0	0		0-1 (0-1)	80

Schedule:

Minutes	Water, gpm	Solids, g/min
0-60	0.2	None
60-120	---	----

(a) AEL's were viewed by two different individuals.



Test time, minutes

TABLE 159. SINGLE-ELEMENT LOOP TEST NO. 204 Date: 6 May 68

Loop no.	3(Al/SS)	Housing:	8" I.D. Aluminum
		Element:	Filters Inc. I-4208 Lot 465[c]
		Canister:	DoD type 1

Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water.	Fuel inlet temperature, °F	80
Solids:	Coarse AC Dust.	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 22, fresh

Date blended with additives: 6 May 68

Anti-icing additive 0.15 vol. %, Dow, Lot 03137126

Corrosion inhibitor 16 lb/Mbbl, Monsanto Santolene "C", Lot NH-04006

Test duration, min	57	Calculated dirt loading, g	234
Fuel throughput, gal	1119	Actual element weight gain, g	212
Average rate, gpm	19.6		

Time	0 min	End test
Meter reading, gal	799	1918
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	2

Analyses on influent fuel:

Time	Pre-test (a)
WSIM, distilled water	64
IFT, distilled water, dyn/cm	38.2

Analyses on injection water:

Time	Post-test
Solids, mg/liter	2.4 (b)
pH	
ST, dyn/cm	72.5

(a) Pre-test was extended for an extra 35 min, because of high Totamitor readings.
(b) Particulate matter present on H_2O test membrane.
(c) Element previously exposed to uninhibited fuel and water and left undisturbed in housing for two weeks.

TABLE 159. SINGLE-ELEMENT LOOP TEST NO. 204 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	4.7	0	1			80
5	4.9	0	1	0.0	0-1	80
10	5.0	2	1			80
15	5.1	3	0			80
20	5.5	4	1			80
25	6.0	3	1			80
30	7.4	0	1			80
35	10.0	0	1		1-2	80
40	16.0	0	1			80
41	20.0	0	1 (a)	0.06	0-1	80
46	32.0	10	28	0.02	20+	80
51	37.5	12	26	0.04 (b)	20+++	80
57	40.0	12	7	0.03	20+++	80

(a) Initial time of peak started at 20 psi + 30 min 30 sec into test, and lasted for a period of 12 min 30 sec or 40 psi. A peak value of 40 occurred at 20 psi + 4 min 45 sec.
(b) Special sample.

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-41	0.002	5.72
	41-57	0.2	----

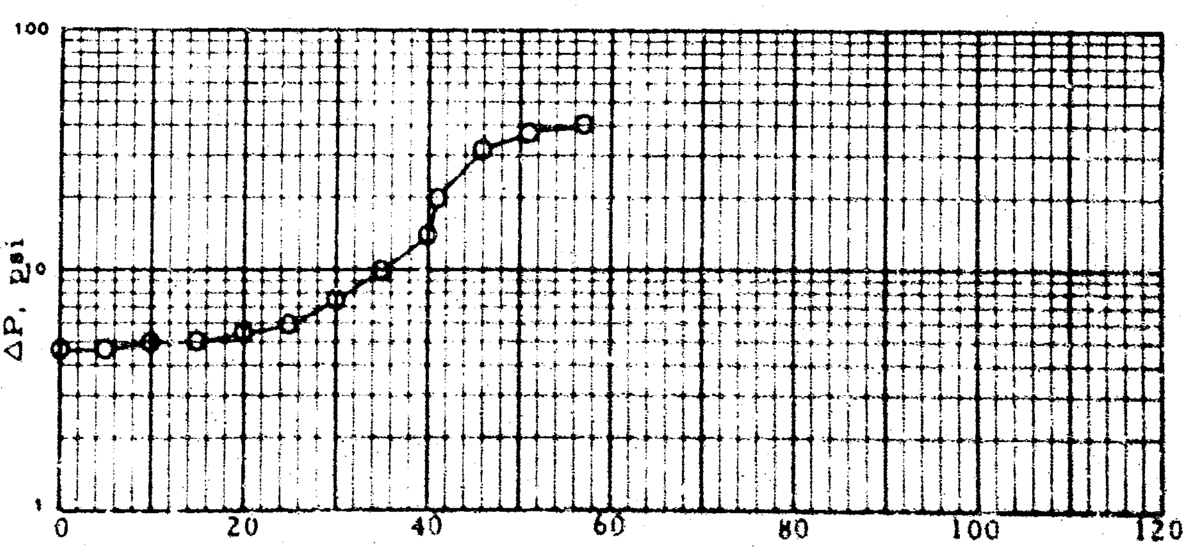


TABLE 160. SINGLE-ELEMENT LOOP TEST NO. 205 Date: 9 May 68

Loop no. 3(Al/SS)		Housing:	8" I.D. Aluminum
		Element:	Filters Inc. I-4208 Lot 465
		Canister:	DoD type 1
Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water.	Fuel inlet temperature, °F	30
Solids:	Coarse AC Dust.	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 22 , fresh
Date blended with additives: 9 May 68
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min	47	Calculated dirt loading, g	183
Fuel throughput, gal	944	Actual element weight gain, g	170
Average rate, gpm	20.1		

Time	0 min	End test
Meter reading, gal	302	1246
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	62
IFT, distilled water, dyn/cm	31.8

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.4
pH	7.4
ST, dyn/cm	72.4

TABLE 160. SINGLE-ELEMENT LOOP TEST NO. 205 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids (a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.0	0	0			80
5	3.5	0	1	0.57 (b)	0	80
10	3.6	0	1			80
15	4.4	0	1			80
20	6.6	0	2			80
25	18.0	0	4			80
26	20.0	0	2 (c)	0.51 (b)	0-1	80
31	25.0	0	1	0.01 (d)	6-7	80
36	26.4	0	1		6-7	80
41	26.8	0	1		4-5	80
46	37.5	0	1			80
47	40.0	0	1	0.09(d)	3-4	80

(a) Balance not zeroing. Re-zeroed and calibrated balance after each test membrane and control pad weighing.
(b) AC Dust present on test membranes.
(c) Initial time of peak started at 20 psi - 2min 10 sec into test, and lasted for a period of 2 min 10 sec or 20 psi. Initial time of peak started at 20 psi or 26 min into test, and lasted for a period of 2 min 30 sec. Peak values of 4 and 3 occurred at 20 psi - 2 min 5 sec and 20 psi + 55 sec respectively.
(d) Pink tint on test membranes.

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-26	0.002	5.72
	26-41	0.2	----
	41-47	0.2	5.72

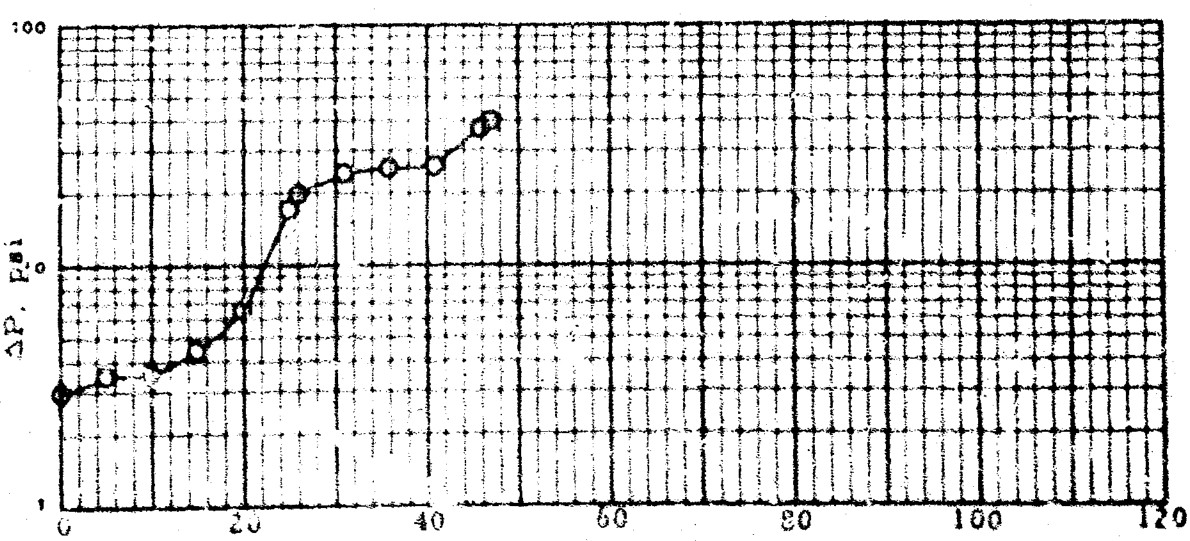


TABLE 161. SINGLE-ELEMENT LOOP TEST NO. 206 Date: 10 May 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 22 , fresh
Date blended with additives: 9 May 68
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min	62
Fuel throughput, gal	1242
Average rate, gpm	20.0

Calculated dirt loading, g	269
Actual element weight gain, g	233

Time	0 min	End test
Meter reading, gal	305	1547
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	65
IFT, distilled water, dyn/cm	33.5

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.5
ST, dyn/cm	72.2

TABLE 161. SINGLE-ELEMENT LOOP TEST NO. 206 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids (a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	3.1	0	0			80
5	3.3	0	0	neg. (b)	0	80
10	3.4	0	0			80
15	3.5	0	0			80
20	3.9	0	0			80
25	4.3	0	0			80
30	4.7	0	0			80
35	5.6	0	0			80
40	9.6	0	0			80
45	16.5	0	0			80
46	20.0	0	1 (c)	0.33 (d)	0-1	[illegible]
51	32.0	0	5	neg. (b)	6-7	[illegible]
56	33.6	0	3		8-9	80
61	35.0	0	3		8-9	80
62	40.0	0	2	0.03 (b)	9-10	80

(a) Balance not zeroing. Re-zeroed and calibrated balance after each test membrane and control pad weighing.
(b) Trace of AC Dust present on test membranes, an also a slight pink tint.
(c) Initial time of peak started at 20 psi or 46 min 20 sec into test, and lasted for a period of 15 min 40 sec or 40 psi. A peak value of 27 occurred at 20 psi + 1 min 45 sec.
(d) AC Dust present on test membrane.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-46	0.002	5.72
46-61	0.2	----
61-[illegible]	0.2	5.72

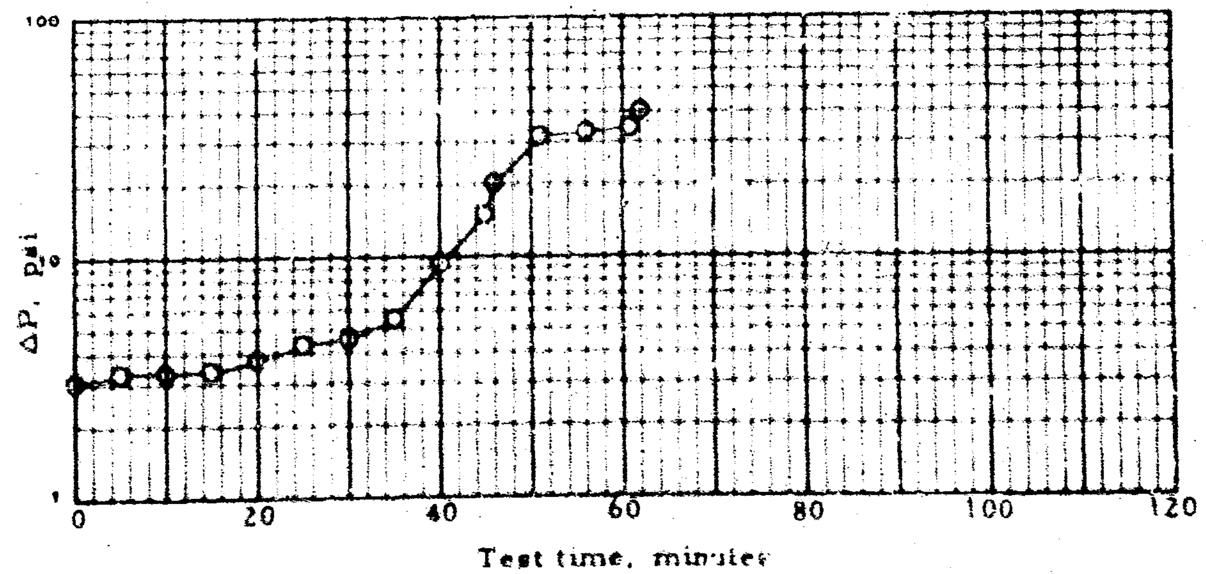


TABLE 162. SINGLE-ELEMENT LOOP TEST NO. 207 Date: 14 May 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 22 , fresh
Date blended with additives: 14 May 68
Anti-icing additive 0.1 vol. %, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min 37
Fuel throughput, gal 749
Average rate, gpm 20.2

Calculated dirt loading, g 126
Actual element weight gain, g 133

Time	0 min	End test
Meter reading, gal	300	1049
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	2

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	57
IFT, distilled water, dyn/cm	33.6

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.4
ST, dyn/cm	70.7

TABLE 162. SINGLE-ELEMENT LOOP TEST NO. 207 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.9	0	0			80
5	3.0	0	0	0.19 (a)	0	80
10	3.2	0	2			80
15	5.0	0	2			80
20	18.8	0	4			80
21	20.0	0	3 (b)	1.39 (a)	0	80
24	27.0	0	50	neg.	19-20	80
26	28.0	0	45		20+++	80
31	30.5	0	44		20+++	80
36	32.0	0	35		20+++	80
37	40.0	0	40	0.05	20+++	80

(a) AC Dust present on test membranes.
(b) Initial time of peak started at 3 min into test, and lasted for a period of 18 min 40 sec. A peak value of 9 occurred at 20 psi + 45 sec. Initial time of peak started at 20 psi + 1 min, and lasted for a period of 1 min 30 sec. A peak value of 50 occurred at 20 psi + 1 min 50 sec. Initial time of peak started at 20 psi + 2 min 30 sec, and lasted for a period of 8 min 50 sec. A peak value of 55 occurred at 20 psi + 4 min 20 sec. Initial time of peak started at 20 psi + 11 min 20 sec into test, and lasted for a period of 2 min. A peak value of 92 occurred at 20 psi + 11 min 20 sec. Initial time of peak started at 20 psi + 13 min 20 sec into test, and lasted for period of 4 min 15 sec. A peak value of 49 occurred at 20 psi + 14 min 20 sec.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-21	0.002	5.72
21-36	0.2	----
36-37	0.2	5.72

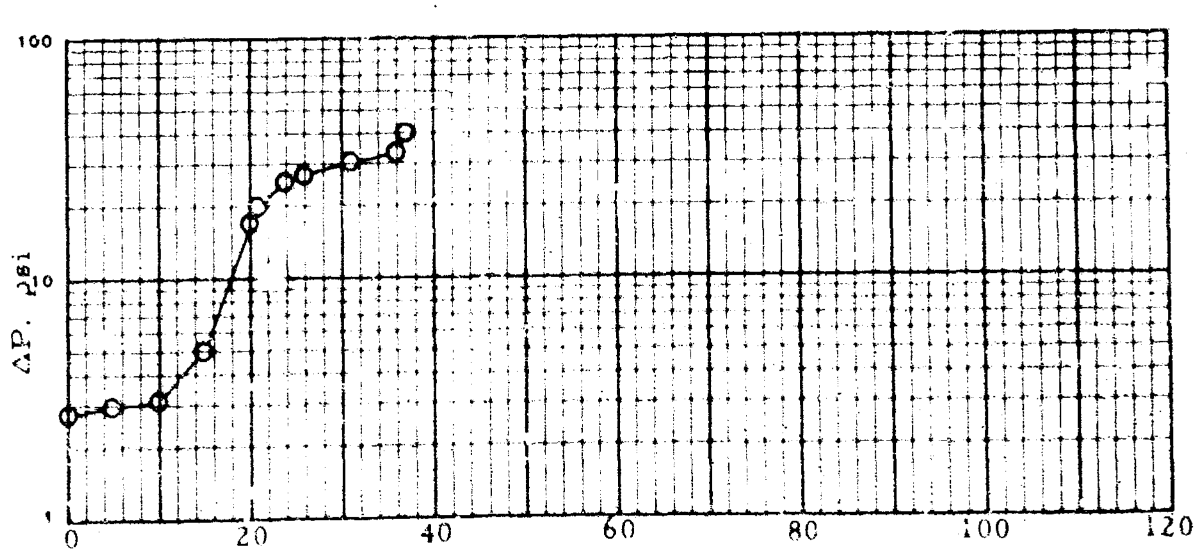


TABLE 163. SINGLE-ELEMENT LOOP TEST NO. 208 Date: 15 May 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 22 , fresh
Date blended with additives: 14 May 68
Anti-icing additive 0.1 vol. %, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min	37
Fuel throughput, gal	749
Average rate, gpm	20.2

Calculated dirt loading, g	126
Actual element weight gain, g	121

Time	0 min	End test
Meter reading, gal	300	1049
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	2

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	36
IFT, distilled water, dyn/cm	34.0

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.5
ST, dyn/cm	70.4

TABLE 163. SINGLE-ELEMENT LOOP TEST NO. 208 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water (c)	Influent fuel temperature, °F
0	3.1	0	0			80
5	3.3	0	1	0.22 (a)	0	80
10	3.5	0	1			80
15	5.1	0	2			80
20	17.2	0	3			80
21	20.0	0	3 (b)	0.92 (a)	0-1	80
26	27.5	0	1	neg.	4-5	80
31	29.3	0	1		4-5	80
36	31.8	0	1		16-17	80
37	40.0	0	1	0.02	15-16	80

(a) AC Dust present on test membranes.
(b) Initial time of peak started at 1 min into test, and lasted for a period of 22 min 35 sec. A peak value of 6 occurred at 20 psi + 55 sec. Initial time of peak started at 20 psi + 14 min into test, and lasted for a period of 2 min 50 sec. A peak value of 3 occurred at 20 psi + 16 min 30 sec.
(c) Commercially prepared pads, bought from Millipore Filter Corp. Date received 5 Mar 68.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-21	0.002	5.72
21-36	0.2	----
36-37	0.2	5.72

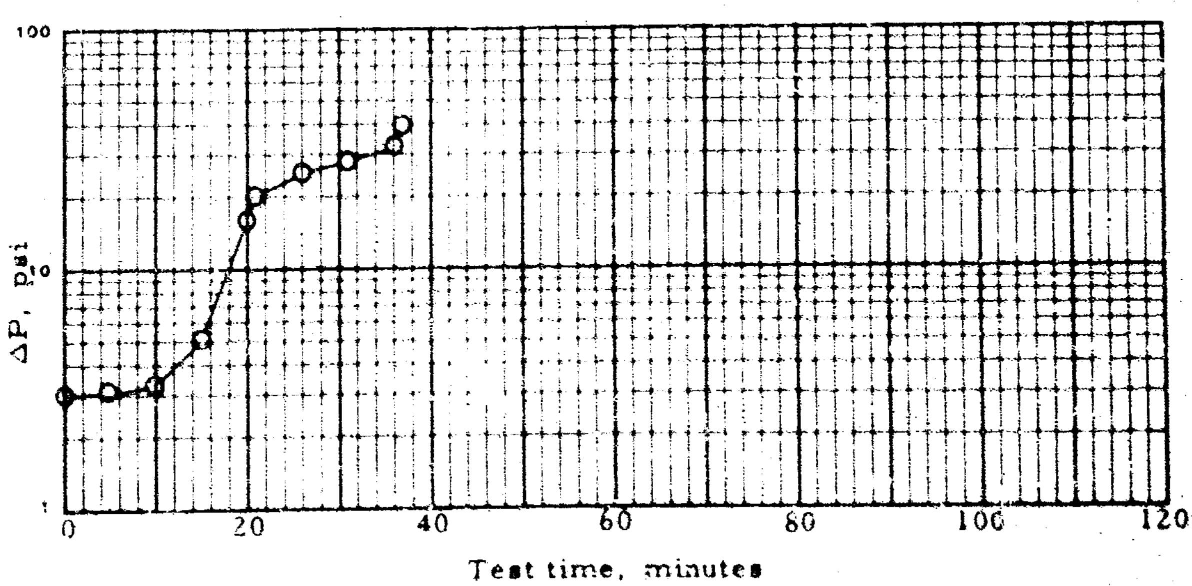


TABLE 164. SINGLE-ELEMENT LOOP TEST NO. 209 Date: 16 May 68

Loop no. 3(Al/SS)		Housing: 8" I.D. Aluminum	
		Element: Filters Inc. I-4208 Lot 465	
		Canister: DoD type 1	
Procedure no. 13-A		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80
Solids: Coarse AC Dust.		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 22 , fresh
Date blended with additives: 15 May 68
Anti-icing additive 0.1 vol.%, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min	46	Calculated dirt loading, g	177
Fuel throughput, gal	910	Actual element weight gain, g	160
Average rate, gpm	19.8		

Time	0 min	End test
Meter reading, gal	300	1210
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test	Post-test
WSIM, distilled water	37	63 (a)
IFT, distilled water, dyn/cm	34.7	

Analyses on injection water:

Time	Post-test	
Solids, mg/liter	0.4 (b)	
pH	7.2 (c)	7.3
ST, dyn/cm	52.3 (c)	71.9

(a) WPAFB filtered tap water was injected.
(b) Particulate matter present on H_2O test membrane.
(c) Possible fuel in sample.

TABLE 164. SINGLE-ELEMENT LOOP TEST NO. 209 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water (f)	Influent fuel temperature, °F
0	3.1	0	0			80
5	3.2	0	1	0.23 (a)	0	80
10	3.3	0	1			80
15	3.9	0	1			80
20	5.5	0	1			80
25	11.3	0	2			80
29	20.0	0	2 (b)	1.07 (c)	0-1	80
34	28.5	0	15	0.24 (d)	20+++	80
39	31.5	0	25		20+++	80
44	34.0	0	3		17-18	80
46	40.0	0	2	neg. (e)	16-17	80

(a) Light AC Dust present on test membrane.
(b) Initial time of peak started at 5 min into test, and lasted for a period of 26 min 15 sec. A peak value of 25 occurred at 20 psi + 1 min 45 sec. Initial time of peak started at 20 psi + 2 min 25 sec into test, and lasted for a period of 14 min 15 sec. A peak value of 29 occurred at 20 psi + 9 min 35 sec.
(c) A6 Dust present on test membrane.
(d) Trace of AC Dust on test membrane and particulate matter, also pink tint present.
(e) Trace of AC Dust present on test membrane, also slight pink tint.
(f) Commerically prepared pads, bought from Millipore Filters Corp. Date received 5 Mar 68.

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-29	0.002	5.72
	29-44	0.2	----
	44-46	0.2	5.72

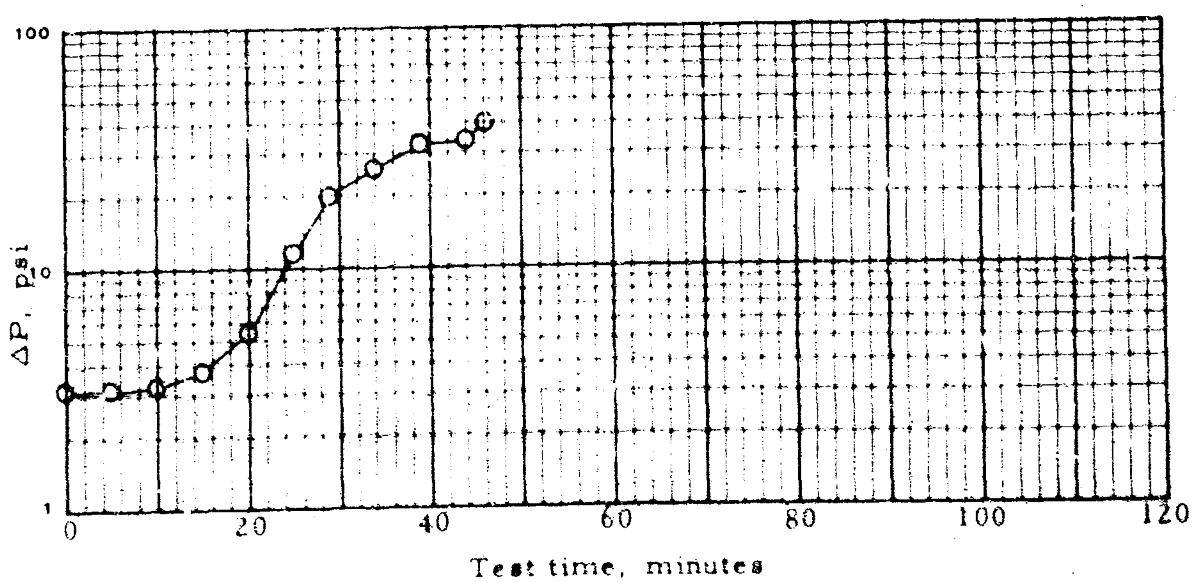


TABLE 165. SINGLE-ELEMENT LOOP TEST NO. 210 Date: 17 May 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 22 , fresh
Date blended with additives: 17 May 68
Anti-icing additive 0.1 vol.%, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min	38	Calculated dirt loading, g	132
Fuel throughput, gal	750	Actual element weight gain, g	123
Average rate, gpm	19.7		

Time	0 min	End test
Meter reading, gal	300	1050
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	2

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	39; 39(a)
IFT, distilled water, dyn/cm	32.2

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.6 (b)
pH	7.3
ST, dyn/cm	(c)

(a) Filtered tap water was injected.
(b) Particulate matter present on H_2O test membrane.
(c) Analysis on sample was not run.

TABLE 165. SINGLE-ELEMENT LOOP TEST NO. 210 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water (d)	Influent fuel temperature, °F
0	3.3	0	0			80
5	3.4	0	0	0.36 (a)	0	80
10	3.6	0	1			80
15	5.0	0	2			80
20	15.7	0	2			80
21	20.0	0	2 (b)	0.83 (a)	0-1	80
26	29.0	0	1	0.05 (c)	4-5	80
31	32.4	0	1		4-5	80
36	34.7	0	1		16-17	80
38	40.0	0	1	0.18 (c)	10-11	80

(a) AC Dust present on test membranes.
(b) Initial time of peak started at 3 min into test, and lasted for a period of 21 min. A peak value of 5 occurred at 20 psi + 45 sec. Initial time of peak started at 20 psi + 10 min 35 sec into test, and lasted for a period of 1 min 25 sec. A peak value of 3 occurred at 20 psi + 11 min 12 sec.
(c) Pink tint present on test membranes.
(d) Commercially prepared pads, bought from Millipore Filters Corp. Date received 5 Mar 68.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-21	0.002	5.72
21-36	0.2	----
36-38	0.2	5.72

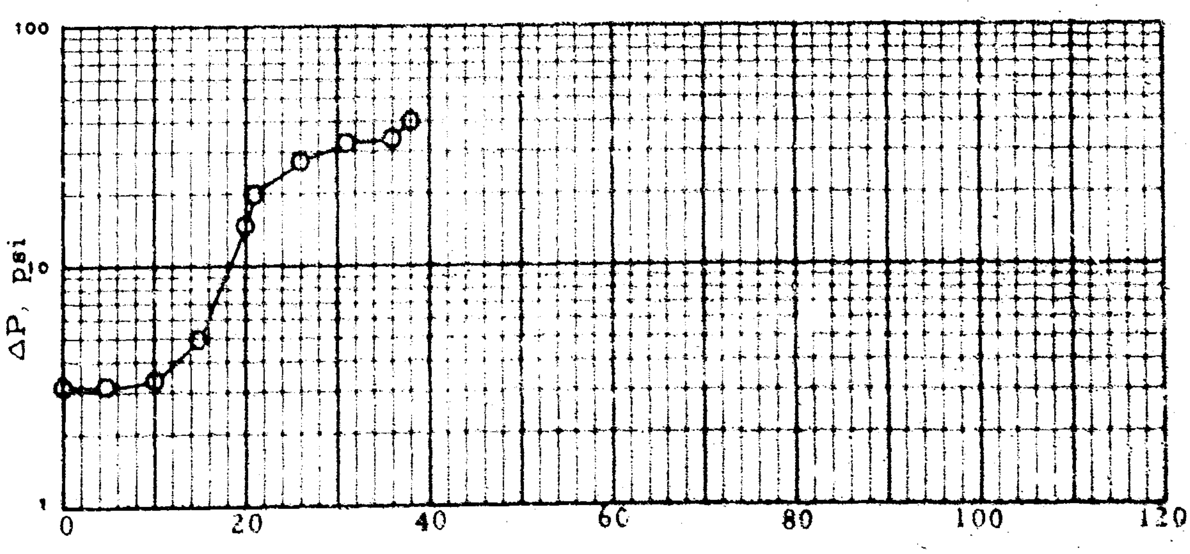


TABLE 166. SINGLE-ELEMENT LOOP TEST NO. 211 Date: 20 May 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 22 , fresh
Date blended with additives: 17 May 68
Anti-icing additive 0.1 vol.%, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min	42	Calculated dirt loading, g	154
Fuel throughput, gal	840	Actual element weight gain, g	143
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	300	1140
Screen ΔP, psi	1	1
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	42
IFT, distilled water, dyn/cm	32.8

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.0
pH	7.3
ST, dyn/cm	72.5

TABLE 166. SINGLE-ELEMENT LOOP TEST NO. 211 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids(a)	Effluent, mg/liter Free water (c)	Influent fuel temperature, °F
0	2.9	0	0			80
5	2.9	0	2	0.71	0	80
10	3.1	0	3			80
15	4.4	0	3			80
20	11.4	0	3			80
23	20.0	0	4 (b)	1.42	1-2	80
28	24.8	0	11	0.40	20+	80
33	26.3	0	24		20+++	80
38	27.6	0	13		20+++	80
40	34.7	0	2			80
42	40.0	0	2	0.51	9-10	80

(a) AC Dust present on test membranes.
(b) Initial time of peak started at 1 min into test, and lasted for a period of 25 min 30 sec. A peak value of 17 occurred at 20 psi + 1 min 30 sec. Initial time of peak started at 20 psi + 2 min 30 sec into test, and lasted for a period of 20 psi + 17 min 30 sec. A peak value of 25 occurred at 20 psi + 12 min.
(c) Commercially prepared pads, bought from Millipore Filters Corp. Date received 5 Mar 68.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-23	0.002	5.72
23-38	0.2	----
38-42	0.2	5.72

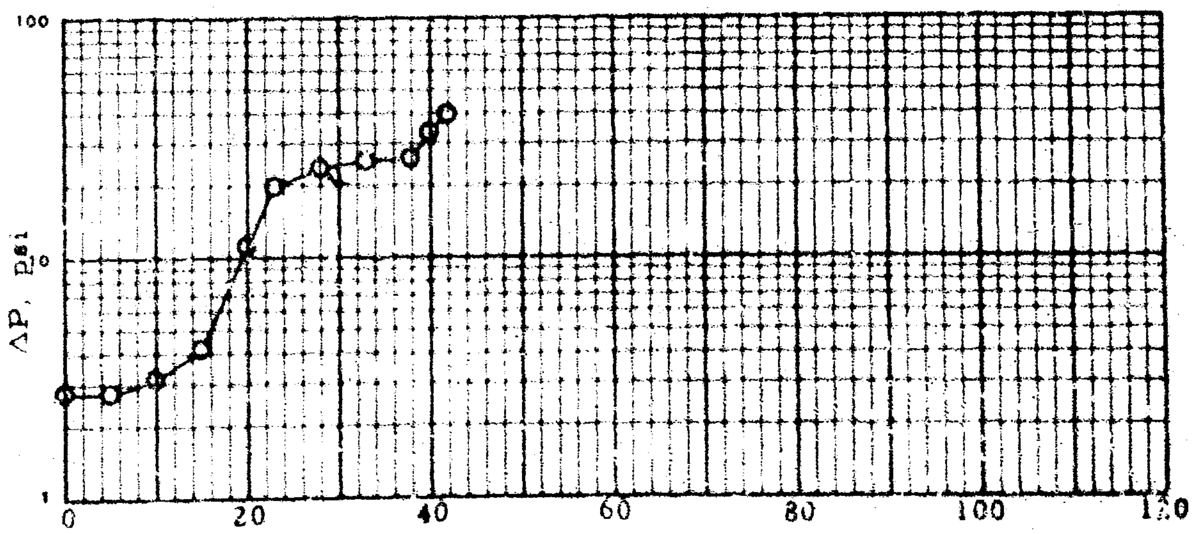


TABLE 167. SINGLE-ELEMENT LOOP TEST NO. 212 Date: 3 June 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-4 **batch no.** None , **fresh** (from Area B Tk 12, 6 Feb 67 receipt)
Date blended with additives: 3 June 68
Anti-icing additive 0.1 vol. %, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min 84
Fuel throughput, gal 1690
Average rate, gpm 20.1

Calculated dirt loading, g 395
Actual element weight gain, g 380

Time	0 min	End test
Meter reading, gal	307	1997
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	2

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	93
IFT, distilled water, dyn/cm	29.4

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.1
pH	7.3
ST, dyn/cm	71.8

TABLE 167. SINGLE-ELEMENT LOOP TEST NO. 212 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.9	0	0			
5	3.0	0	0	0.07	1-2	80
10	3.0	0	1			30
15	3.0	0	1			80
20	3.1	0	1			80
25	3.2	0	1			80
30	3.5	0	1			80
35	3.9	0	1			80
40	3.5	0	1			80
45	4.4	0	1			80
50	5.6	0	1			80
55	7.9	0	1			80
60	12.0	0	1			80
65	17.9	0	1			80
67	20.0	0	1	0.41	1-2	80
72	26.5	0	1	0.33	2-3	80
77	28.0	0	1		4-5	80
82	29.4	0	1		3-4	80
84	40.0	0	1	0.09	8-9	80

Initial time of peak started at 20 psi + 45 sec into test, and lasted for a period of 3 min. A peak value of 3 occurred at 20 psi + 55 sec.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-67	0.002	5.72
67-82	0.2	----
82-84	0.2	5.72

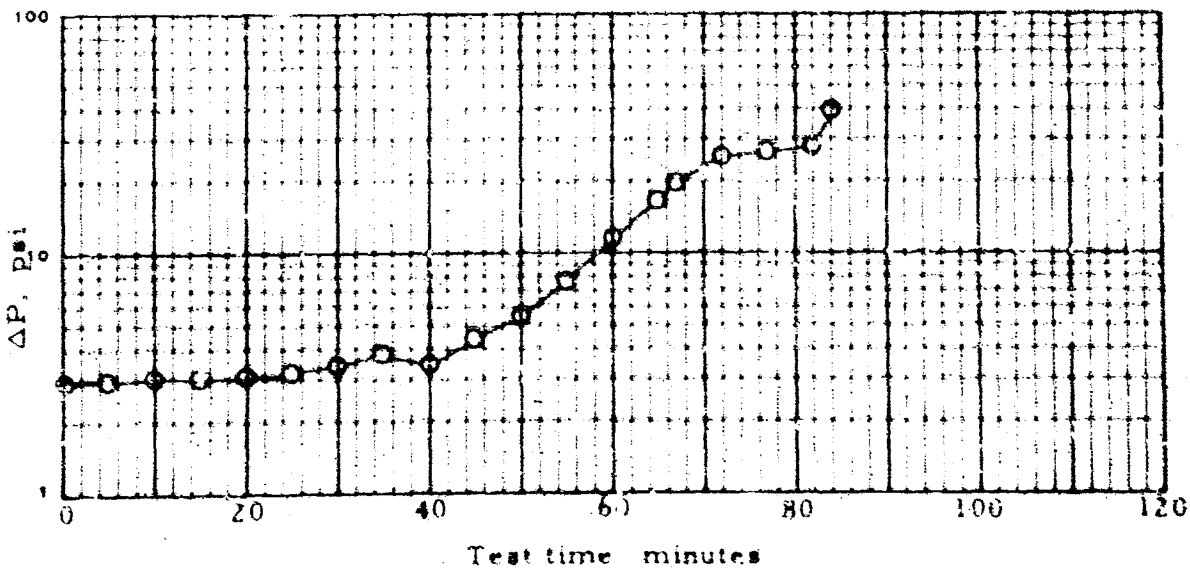


TABLE 168. SINGLE-ELEMENT LOOP TEST NO. 213 Date: 4 June 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-4 batch no. None, fresh (from Area B Tk 12, 6 Feb 67 receipt)
Date blended with additives: 4 June 68
Anti-icing additive 0.1 vol. %, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Du Pont AFA-1, Lot 37

Test duration, min 80
Fuel throughput, gal 1581
Average rate, gpm 19.8

Calculated dirt loading, g 372
Actual element weight gain, g 373

Time	0 min	End test
Meter reading, gal	300	1881
Screen ΔP, psi	0	0
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	94
IFT, distilled water, dyn/cm	30.2

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.3
pH	7.3
ST, dyn/cm	71.4

TABLE 168. SINGLE-ELEMENT LOOP TEST NO. 213 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.0	0	0			80
5	2.0	0	0	0.11	0-1	80
10	2.0	0	0			80
15	2.2	0	0			80
20	2.4	0	0			80
25	2.5	0	0			80
30	2.9	0	0			80
35	3.4	0	0			80
40	4.4	0	0			80
45	5.5	0	0			80
50	7.1	0	0			80
55	9.9	0	0			80
60	16.0	0	0			80
63	20.0	0	0 (a)	0.27	1-2	80
68	25.5	0	1	0.16	2-3	80
73	24.5	0	1		3-4	80
78	24.7	0	0		4-5	80
80	40.0	0	1	0.17	13-14	80

(a) Initial time of peak started at 20 psi + 20 sec into test, and lasted for a period of 4 min 10 sec. A peak value of 2 occurred at 20 psi + 45 sec.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-63	0.002	5.72
63-78	0.2	----
78-80	0.2	5.72

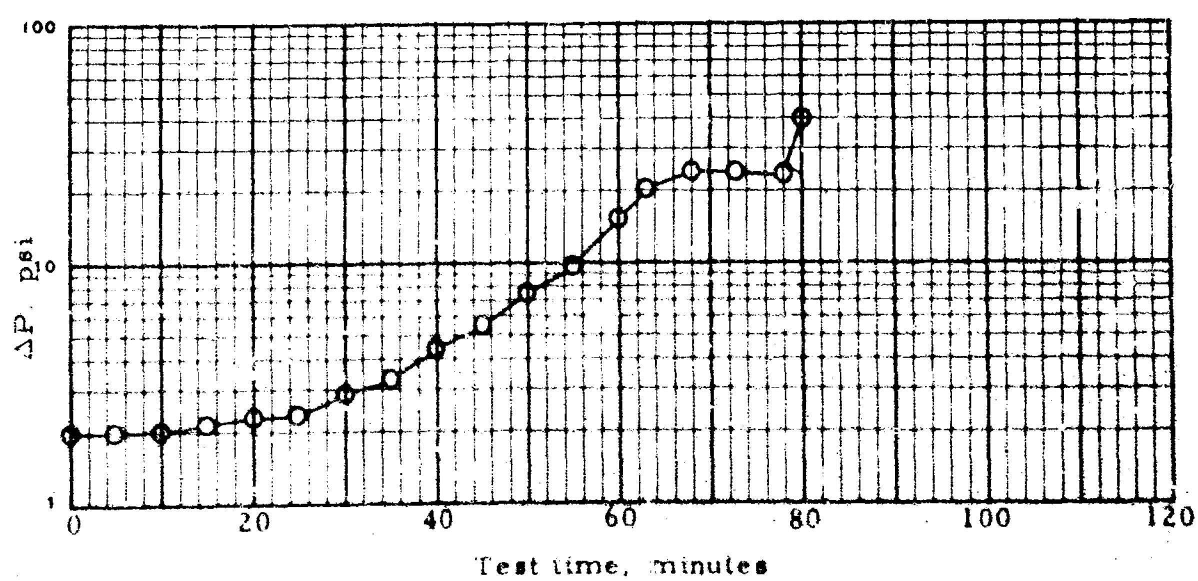


TABLE 169. SINGLE-ELEMENT LOOP TEST NO. 214 Date: 5 June 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-4 batch no. None ,fresh (from Area B Tk 12, 6 Feb 67 receipt)
Date blended with additives: 5 June 68
Anti-icing additive 0.1 vol.%, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Du Pont AFA-1 , Lot 37
1 mg/L APFL ASA-3 35001 (68-4)

Test duration, min 60
Fuel throughput, gal 1200
Average rate, gpm 20.0

Calculated dirt loading, g 257
Actual element weight gain, g 279 (a)

Time	0 min	End test
Meter reading, gal	300	1500
Screen ΔP, psi	0	0
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	63
IFT, distilled water, dyn/cm	27.3

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.8
pH	7.3
ST, dyn/cm	71.4

(a) Gain probably due to Omega Dust Feeder.

TABLE 169. SINGLE-ELEMENT LOOP TEST NO. 214 (Cont'd)

Time, min	ΔP, psi	Totamiter Infl.	Totamiter Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.0	0	0			80
5	2.1	0	0	0.06	2-3	80
10	2.1	0	0			80
15	2.2	0	0			80
20	2.4	0	0			80
25	2.9	0	0			80
30	3.0	0	0			80
35	6.9	0	0			80
40	13.4	0	0			80
43	20.0	0	1 (a)	0.48	3-4	80
48	29.9	0	2	0.24	7-8	80
53	31.5	0	0		17-18	80
58	34.2	0	0		14-15	80
60	40.0	0	0	0.17	16-17	80

(a) Initial time of peak started at 20 psi + 1 min into test, and lasted for a period of 8 min. A peak value of 4 occurred at 20 psi + 1 min 15 sec.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-43	0.002	5.72
43-58	0.2	----
58-60	0.2	5.72

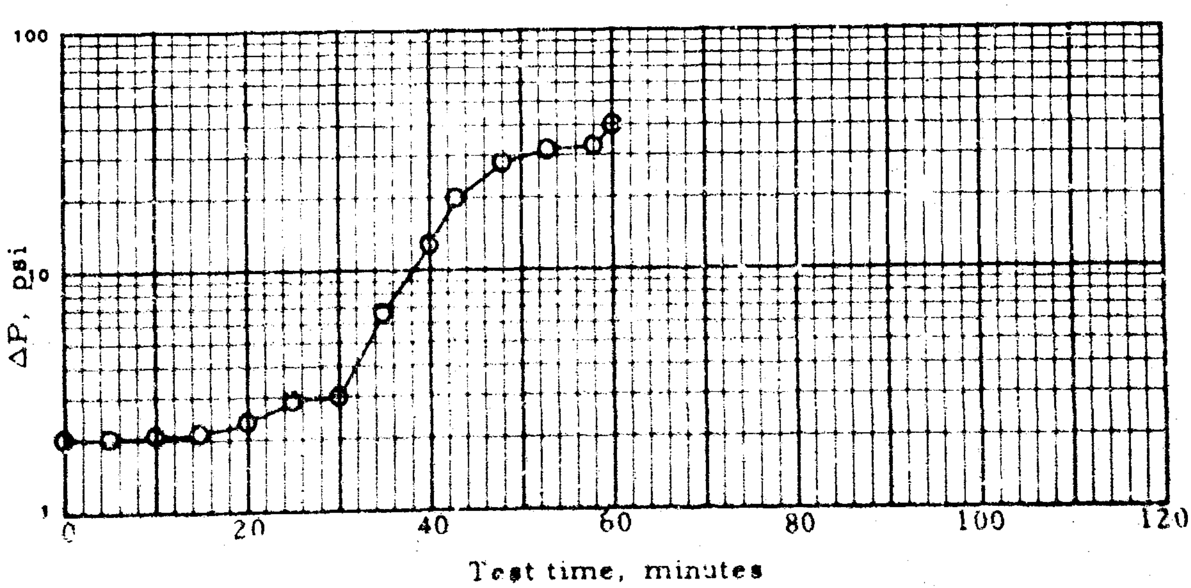


TABLE 170. SINGLE-ELEMENT LOOP TEST NO. 215 Date: 6 June 68

Loop no. 3(Al/SS)	Housing: 8" I.D. Aluminum
	Element: Filters Inc. I-4208 Lot 465
	Canister: DoD type 1

Procedure no. 13-A	Fuel flow, gpm	20
Water: Filtered tap water.	Fuel inlet temperature, °F	80
Solids: Coarse AC Dust.	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-4 batch no. None , fresh (from Area B Tk 12, 6 Feb 67 receipt)
Date blended with additives: 6 June 68

Anti-icing additive	0.1	vol. %,	Dow, Lot 03187126	
Corrosion inhibitor	4	lb/Mbbl,	Du Pont AFA-1	, Lot 37
	1	mg/L	APFL ASA-3	, 85001 (68-4)

Test duration, min	54	Calculated dirt loading, g	280
Fuel throughput, gal	1078	Actual element weight gain, g	287
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	300	1378
Screen ΔP, psi	0	0
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	67
IFT, distilled water, dyn/cm	25.4 (a)

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.3
pH	7.3
ST, dyn/cm	69.6 (a)

(a) Temperature of lab was approximately 89 °F during analysis of samples.

TABLE 170. SINGLE-ELEMENT LOOP TEST NO. 215 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	1.9	0	0			80
5	2.0	0	0	0.18	1-2	80
10	1.9	0	0			80
15	2.0	0	0			80
20	2.1	0	0			80
25	2.4	0	0			80
30	3.0	0	1			80
35	4.3	0	1			80
40	7.9	0	1			80
45	13.7	0	1			80
49	20.0	0	1 (a)	1.57	3-4	80
54	40.0	0	2	0.51 (b)	10-11 (c)	80
					18-19 (d)	80

(a) Initial time of peak started at 20 psi + 40 sec into test, and lasted for a period of 6 min 50 sec. Peak value of 11 occurred at 20 psi + 55 sec.
(b) 20 psi + 5 min and 40 psi sample.
(c) 20 psi + 5 min AEL.
(d) 40 psi AEL; also AEL was irregular because about 1000 ml of fuel was allowed to fill container.

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-49	0.002	5.72
	49-54	0.2	----

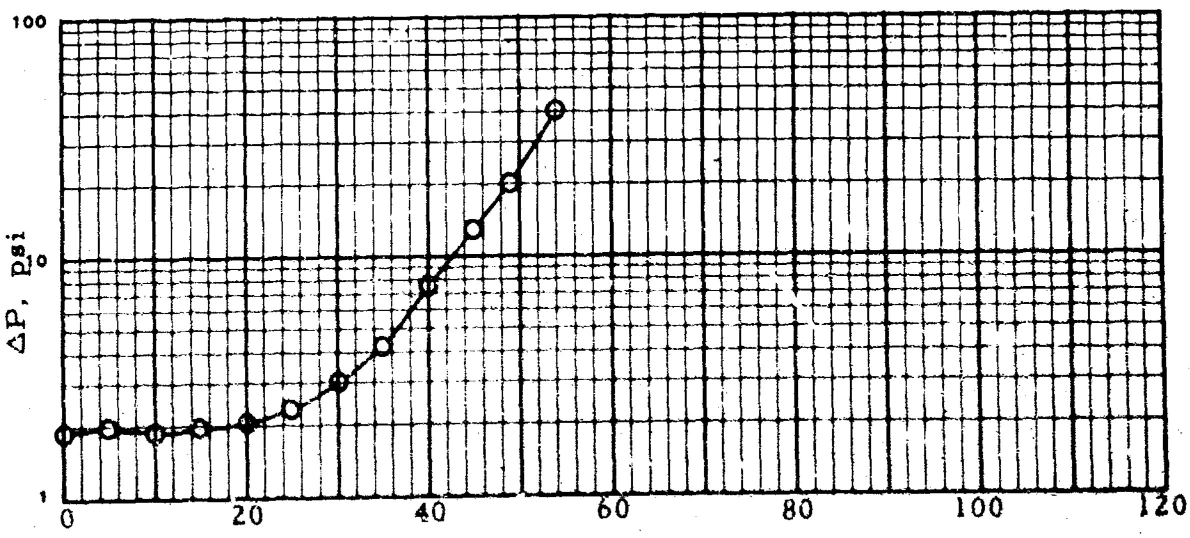


TABLE 171. SINGLE-ELEMENT LOOP TEST NO. 216 Date: 7 June 68

Loop no. 3(Al/SS)	Housing: 8" I.D. Aluminum
	Element: Filters Inc. I-4208 Lot 465
	Canister: DoD type 1

Procedure no. 13-A		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80
Solids: Coarse AC Dust.		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-4 batch no. None , fresh (from Area B Tk 12, 6 Feb 67 receipt)
Date blended with additives: 7 June 68
Anti-icing additive 0.1 vol.%, Dow, Lot 03187126
Corrosion inhibitor 4 lb/Mbbl, Du Pont AFA-1 , Lot 37
1 mg/L APFL ASA-3 85001 (68-4)

Test duration, min	49	Calculated dirt loading, g	223
Fuel throughput, gal	983	Actual element weight gain, g	233
Average rate, gpm	20.1		

Time	0 min	End test
Meter reading, gal	300	1283
Screen ΔP, psi	0	0
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	72
IFT, distilled water, dyn/cm	25.9 (a)

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.2
pH	7.4
ST, dyn/cm	69.4 (a)

(a) Temperature of lab was approximately 90 °F during analysis of samples.

TABLE 171. SINGLE-ELEMENT LOOP TEST NO. 216 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids (a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	1.9	0	0			80
5	2.0	0	0	0.07	0-1	80
10	2.0	0	0			80
15	2.1	0	0			80
20	2.4	0	0			80
25	3.0	0	1			80
30	4.8	0	1			80
35	10.7	0	1			80
39	20.0	0	1 (b)	0.72	3-4	80
44	36.0	0	1	0.22	8-9	80
49	40.0	0	1	0.21	18-19	80

(a) Black particulate matter present on test membranes.
(b) Initial time of peak started at 20 psi + 40 sec into test, and lasted for a period of 3 min 20 sec. A peak value of 5 occurred at 20 psi + 55 sec.

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-39	0.002	5.72
	39-49	0.2	----

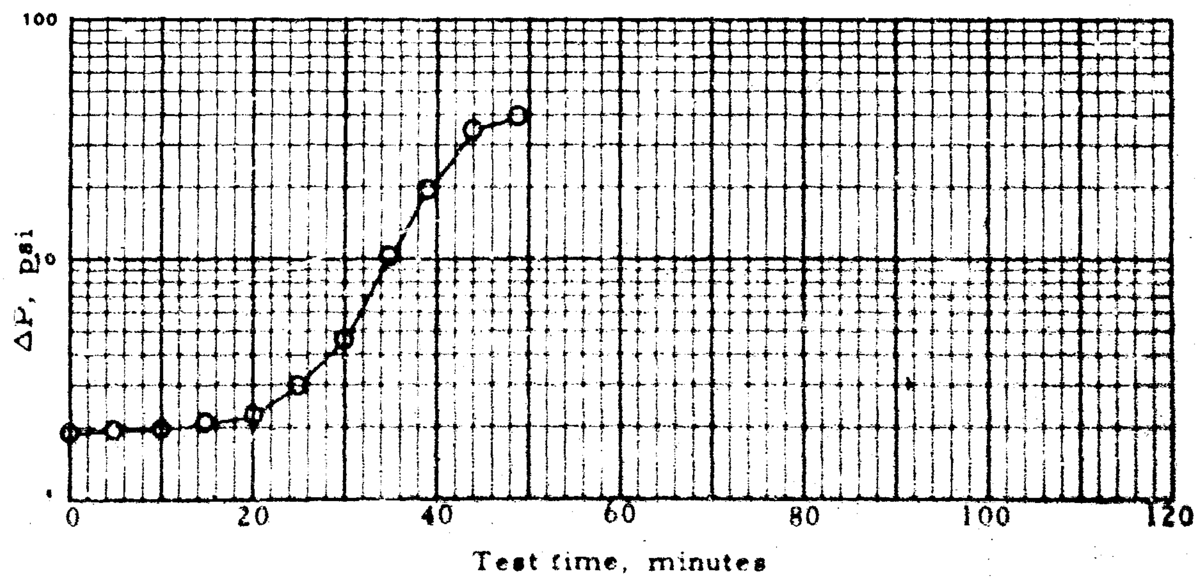


TABLE 172. SINGLE-ELEMENT LOOP TEST NO. 217 Date: 11 June 68

Loop no. 3(Al/SS)		Housing: 8" I.D. Aluminum	
		Element: Filters Inc. I-4208 Lot 465	
		Canister: DoD type 1	
Procedure no. 13-A		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80
Solids: Coarse AC Dust.		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-4 batch no. None , fresh (from Area B Tk 12, 6 Feb 67 receipt)
Date blended with additives: 11 June 68
Anti-icing additive 0.1 vol. %, Dow, Lot 03187126
Corrosion inhibitor lb/Mbbl, , Lot
1 mg/L APFL ASA-3 85001 (68-4)

Test duration, min	127	Calculated dirt loading, g	641
Fuel throughput, gal	2532	Actual element weight gain, g	534 (a)
Average rate, gpm	19.9		

Time	0 min	End test
Meter reading, gal	300	2832
Screen ΔP, psi	0	0
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	85
IFT, distilled water, dyn/cm	42.7

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.6
pH	7.4
ST, dyn/cm	70.6

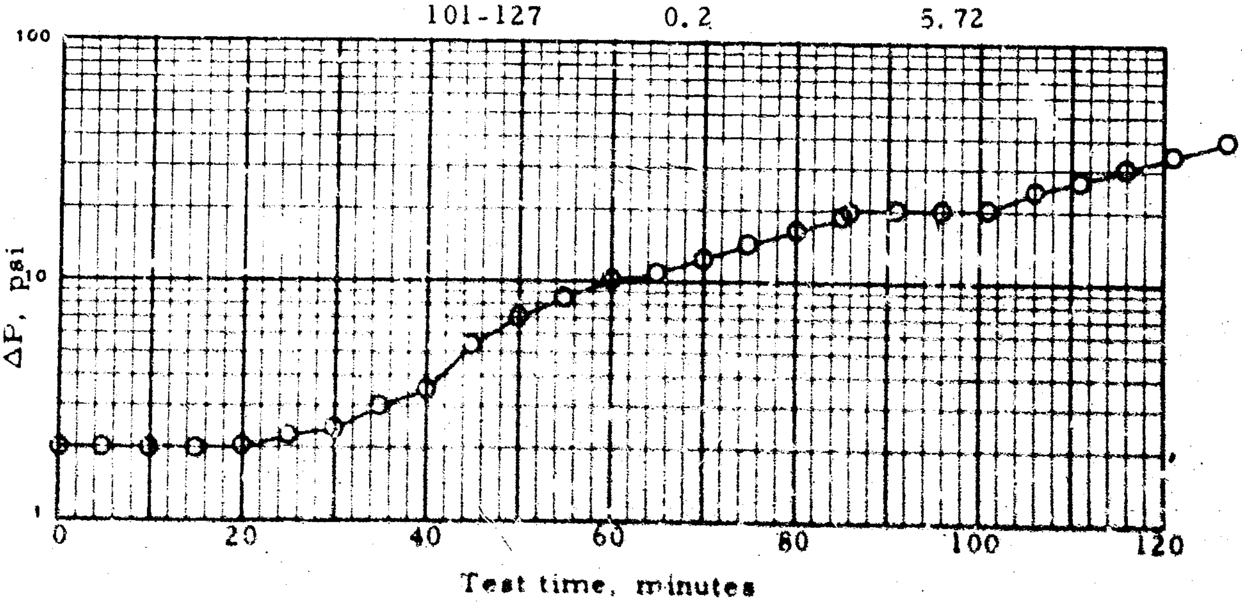
(a) Loss due to Omega Dust Feeder.

TABLE 172. SINGLE-ELEMENT LOOP TEST NO. 217 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.0	0	0			
5	2.0	0	0	0.10	0	80
10	2.0	0	0			80
15	2.0	0	0			80
20	2.1	0	0			80
25	2.3	0	0			80
30	2.5	0	0			80
35	3.0	0	0			80
40	3.6	0	0			80
45	5.4	0	0			80
50	7.0	0	0			80
55	8.6	0	0			80
60	10.8	0	0			80
65	12.6	0	0			80
70	14.5	0	0			80
75	16.1	0	0			80
80	17.5	0	0			80
85	19.5	0	0			80
86	20.0	0	0 (a)	0.14	16-17	80
91	20.4	0	3	0.12	17-18	80
96	20.5	0	2		16-17	80
101	20.5	0	1		5-6	80
106	25.7	0	2			80
111	27.6	0	2			80
116	31.2	0	3			80
121	35.3	0	3			80
127	40.0	0	27	0.18 (b)	20+	80

Schedule:

Minutes	Water, gpm	Solids, g/min
0-86	0.002	5.72
86-101	0.2	----
101-127	0.2	5.72



(a) Initial time of peak started at 20 psi + 30 sec into test, and lasted for a period of 40 min 30 sec. A peak value of 28 occurred at 20 psi + 40 min 45 sec.

(b) Pieces of matter present on test membrane believed to be Teflon tape.

TABLE 173. SINGLE-ELEMENT LOOP TEST NO. 218 Date: 12 June 68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-4 batch no. None , fresh (from Area B Tk 12, 6 Feb 67 receipt)
Date blended with additives: 12 June 68
Anti-icing additive 0.1 vol.%, Dow, Lot 03187126
Corrosion inhibitor lb/Mbbl, , Lot
1 mg/L AFFL ASA-3 85001 (68-4)

Test duration, min 111
Fuel throughput, gal 2211
Average rate, gpm 19.9

Calculated dirt loading, g 549
Actual element weight gain, g 506 (a)

Time	0 min	End test
Meter reading, gal	298	2509
Screen ΔP, psi	0	0
Cleanup ΔP, psi	1	0

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	96
IFT, distilled water, dyn/cm	42.7

Analyses on injection water:

Time	Post-test
Solids, mg/liter	0.6
pH	7.6
ST, dyn/cm	72.0

(a) Loss probably due to Omega Dust Feeder.

TABLE 173. SINGLE-ELEMENT LOOP TEST NO. 218 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.0	0	0			80
5	2.3	0	0	0.06	0	80
10	2.3	0	0			80
15	2.5	0	0			80
20	2.6	0	0			80
25	3.0	0	0			80
30	3.6	0	0			80
35	5.0	0	0			80
40	7.5	0	0			80
45	11.0	0	0			80
50	15.0	0	0			80
55	18.1	0	0			80
59	20.0	0	0	0.13	3-4	80
64	25.0	0	1	0.04	5-6	80
69	26.0	0	1		2-3	80
74	26.8	0	1		2-3	80
75	27.9	0	1			80
80	29.9	0	1			80
85	31.0	0	1			80
90	32.5	0	1			80
95	33.9	0	1			80
100	35.6	0	1			80
105	38.0	0	1			80
111	40.0	0	1	neg.	7-8	80

Schedule:

Minutes	Water, gpm	Solids, g/min
0-59	0.002	5.72
59-74	0.2	----
74-111	0.2	5.72

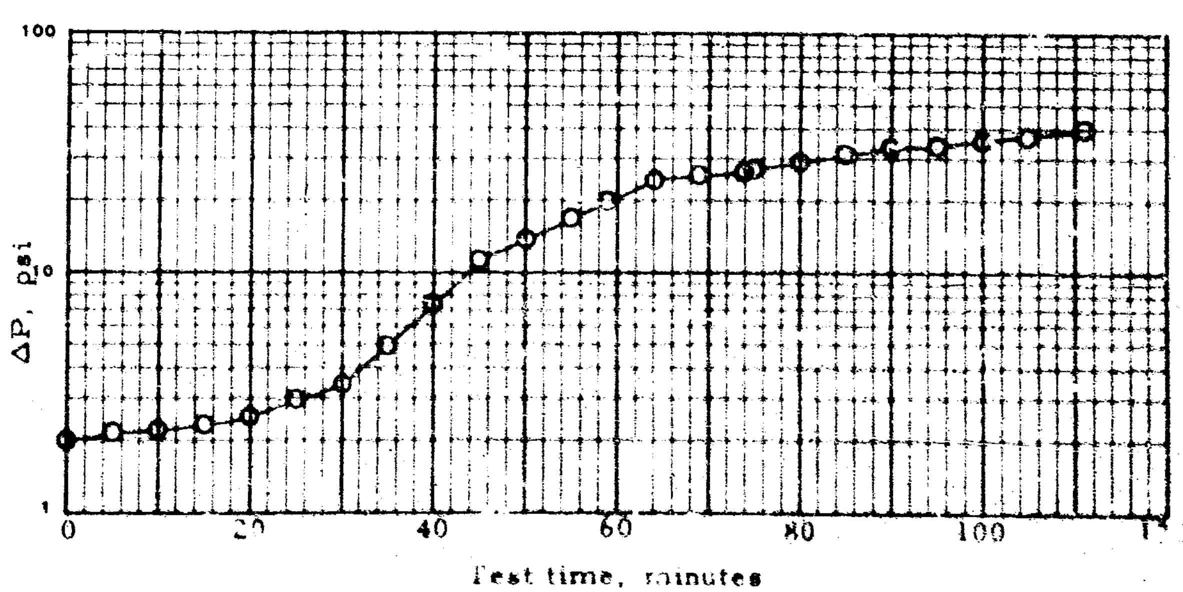


TABLE 174. SINGLE-ELEMENT LOOP TEST NO. 219 Date: 13 June 68

Loop no. 3(Al/SS)		Housing:	8" I.D. Aluminum
		Element:	Filters Inc. I-4208 Lot 465
		Canister:	DoD type 1
Procedure no. 13-A		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80
Solids: Coarse AC Dust.		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-4 batch no.None , fresh (from Area B Tk 12, 6 Feb 67 receipt)
Date blended with additives: 12 June 68
Anti-icing additive 0.1 vol.%, Dow, Lot 03187126
Corrosion inhibitor lb/Mbbl, , Lot
1 mg/L APFL ASA-3 85001 (68-4)

Test duration, min	123	Calculated dirt loading, g	618
Fuel throughput, gal	2457	Actual element weight gain, g	607
Average rate, gpm	20.0		

Time	0 min	End test
Meter reading, gal	291	2748
Screen ΔP, psi	0	0
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Pre-test
WSIM, distilled water	92
IFT, distilled water, dyn/cm	42.5

Analyses on injection water

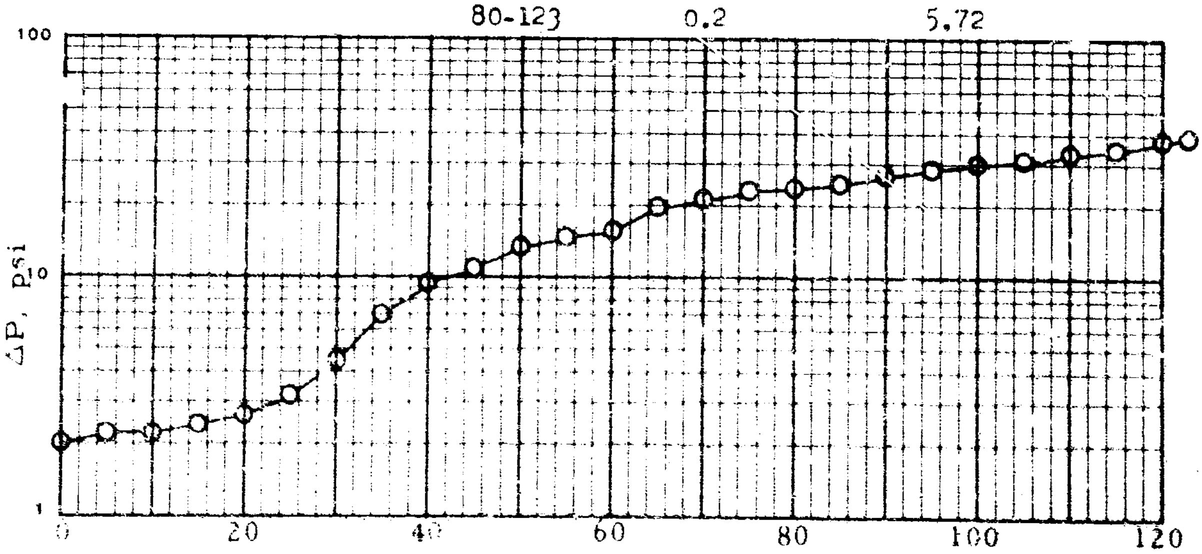
Time	Post-test
Solids, mg/liter	0.5
pH	7.8
ST, dyn/cm	71.5

TABLE 174. SINGLE-ELEMENT LOOP TEST NO. 219 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids(a)	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.1	0	0			81
5	2.3	0	0	0.11	0	80
10	2.3	0	0			80
15	2.5	0	0			80
20	2.7	0	0			80
25	3.3	0	0			80
30	4.6	0	0			80
35	7.0	0	0			80
40	9.5	0	0			80
45	11.7	0	0			80
50	14.8	0	0			80
55	16.0	0	0			80
60	17.8	0	0			80
65	20.0	0	0	0.05 (b)	2-3 (d)	80
70	22.5	0	0	0.08	4-5 (")	80
75	24.0	0	0		2-3 (")	80
80	24.9	0	0		3-4 (")	80
85	26.5	0	0			80
90	28.0	0	0			80
95	29.5	0	0			80
100	30.5	0	0			80
105	32.3	0	0			80
110	34.6	0	0			80
115	36.6	0	0			80
120	38.5	0	0			80
123	40.0	0	0	0.08 (c)	13-14	80

Schedule:

Minutes	Water, gpm	Solids, g/min
0-65	0.002	5.72
65-80	0.2	----
80-123	0.2	5.72



(a) Black particulate matter present on test membranes.
(b) Control membrane tore all pieces were recovered and weighed.
(c) Test membrane tore. One black speck remained on control pad after test pad was removed from it.
(d) AEL disk droplet size appeared extremely small observed by RJ.

TABLE 175. SINGLE-ELEMENT LOOP TEST NO. 220 Date: 29-July-68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23, Fresh
Date blended with additives: 29-July-68
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Santolene C, Lot NH04-006

Test duration, min 52
Fuel throughput, gal 1001
Average rate, gpm 19.3

Calculated dirt loading, g 212
Actual element weight gain, g 178

Time	0 min	End Test
Meter reading, gal	274	1275
Screen ΔP, psi	3	0
Cleanup ΔP, psi	2	1

Analyses on influent fuel:	Uninhibited	Post Clay Filter	Pre Test	Post Test
Time				
WSIM, distilled water	90	98	71	83
IFT, distilled water, dyn/cm	40.3	41.2	32.8	32.3
IFT, inj. water, dyn/cm	39.9	41.3	32.9	32.7

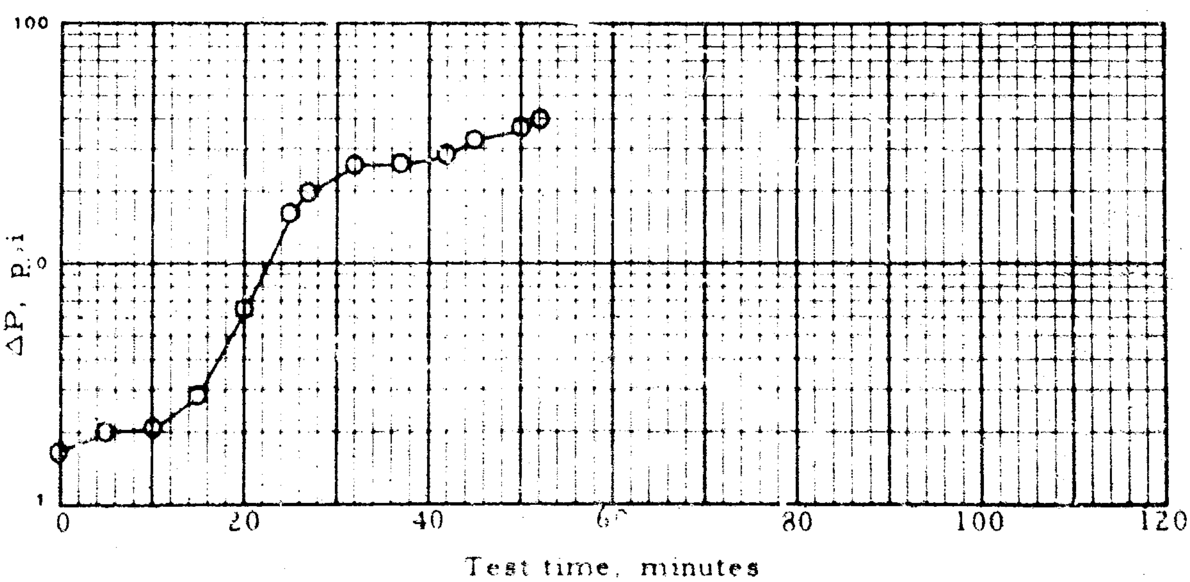
Analyses on injection water:	Post Test
Time	
Solids, mg/liter	0.1
pH	9.1
ST, dyn/cm	70.8

TABLE 175. SINGLE-ELEMENT LOOP TEST NO. 220 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	1.7	0	0			80
5	2.0	0	0	0.16	0-1	80
10	2.1	0	0			80
15	2.9	0	0			80
20	6.6	0	0			80
25	17.0	0	0			80
27	20.0	0	0	0.1	0-1	80
32	25.2	0	0	0.0[illegible]	2-3	80
37	26.9	0	0		2-3	80
42	2[illegible].4	0	0		2-3	80
45	34.0	0	0			80
50	3[illegible].0	0	0			80
52	40.0	0	0	0.02	7-3	80

Schedule:

Minutes	Water, gpm	Solids, g/min
0-27	0.002	[illegible].72
27-42	.2	----
42-52	0.2	[illegible].[illegible]2



NOT REPRODUCIBLE

TABLE 176. SINGLE-ELEMENT LOOP TEST NO. 221 Date: 30-July-68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , Reused
Date blended with additives: 30-July-68
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Santolene C , Lot NH04-006

Test duration, min 52
Fuel throughput, gal 1054
Average rate, gpm 20.3

Calculated dirt loading, g 212
Actual element weight gain, g 197

Time	0 min	End Test
Meter reading, gal	3006	4060
Screen ΔP, psi	4	1
Cleanup ΔP, psi	3	2

Analyses on influent fuel:			
Time	Post Clay Filter	Pre Test	Post Test
WSIM, distilled water	97	74	79
IFT, distilled water, dyn/cm	45.8	38.0	39.9
IFT, inj. water, dyn/cm	45.3	37.4	39.5

Analyses on injection water:	
Time	Post Test
Solids, mg/liter	0.1
pH	7.2
ST, dyn/cm	71.0

TABLE 176. SINGLE-ELEMENT LOOP TEST NO. 221 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.0	0	1			80
5	2.4	0	1	neg.	0-1	80
10	2.3	0	1			80
15	2.6	0	1			80
20	4.3	0	1			80
25	7.0	0	1			80
30	12.5	0	1			80
35	20.0	0	1	0.02	1-2	80
40	28.0	0	1	neg.	2-3	80
45	32.0	0	1		4-5	80
50	34.0	0	1		4-5	80
52	40.0	0	1	neg.	11-12	80

Schedule:

Minutes	Water, gpm	Solids, g/min
0-35	0.002	5.72
35-50	0.2	----
50-52	0.2	5.72

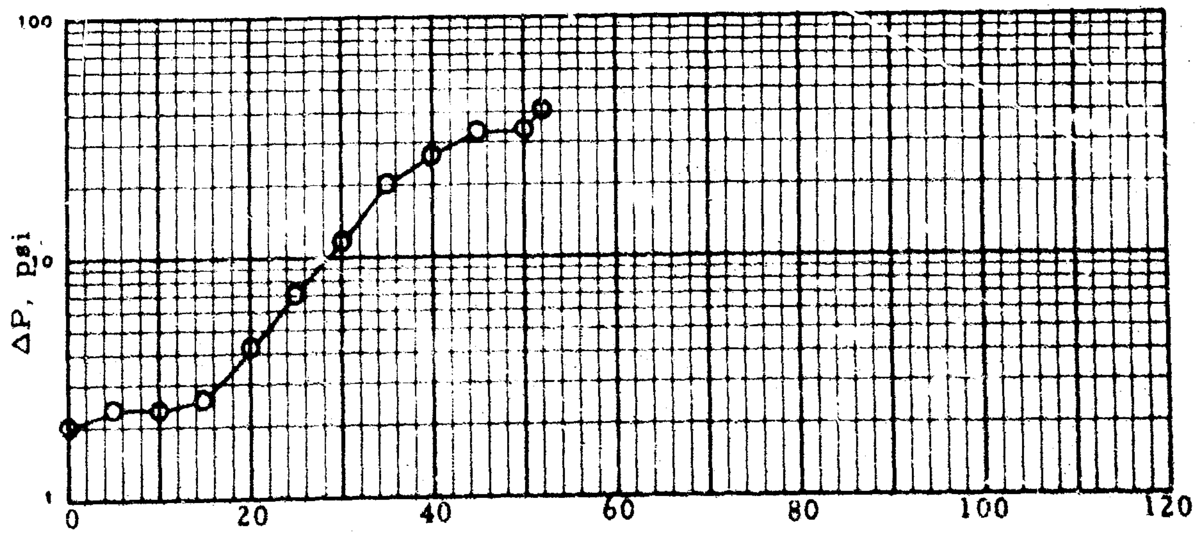


TABLE 177. SINGLE-ELEMENT LOOP TEST NO. 222 Date: 31-July-68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. X-4208 Lot 465
Canister: Dod type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 **batch no.** 23 , Reused
Date blended with additives: 31-July-68
Anti-icing additive 0.15 **vol. %, Dow, Lot** 03187126
Corrosion inhibitor 16 **lb/Mbbl,** Santolene C **, Lot** NH04-006

Test duration, min	52[a]	Calculated dirt loading, g	212
Fuel throughput, gal	1038	Actual element weight gain, g	202
Average rate, gpm	20.0		

Time	0 min	End Test
Meter reading, gal	310	1348
Screen ΔP, psi	3	3
Cleanup ΔP, psi	1	3

Analyses on influent fuel: Time	Post Clay Filter	Pre Test	Post Test
WSIM, distilled water	97	77	81
IFT, distilled water, dyn/cm	44.3	36.0	38.4
IFT, inj. water, dyn/cm	44.3	36.4	38.3

Analyses on injection water: Time	Post Test
Solids, mg/liter	0
pH	7.1
ST, dyn/cm	70.7

a. The test was terminated due to what was believed to be a rupture in the element.

TABLE 177. SINGLE-ELEMENT LOOP TEST NO. 222 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	1.6	0	0			80
5	1.8	0	0	0.15	0-1	80
10	2.0	0	0			80
15	2.5	0	0			80
20	6.0	0	0			80
25	13.5	0	0			80
29	20.0	0	1	0.25	4-5	80
34	25.0	0	14	0.00	20+	80
39	26.6	0	24		20+	80
44	27.5	0	38		20+++	80
45	32.0	0	100		20+++	80
50	36.0	0	100		20+++	80
52	28.5	0	100	10.57[a]	20+++	80

a. AC Dust present on test membrane.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-29	0.002	5.72
29-44	0.2	----
44-52	0.2	5.72

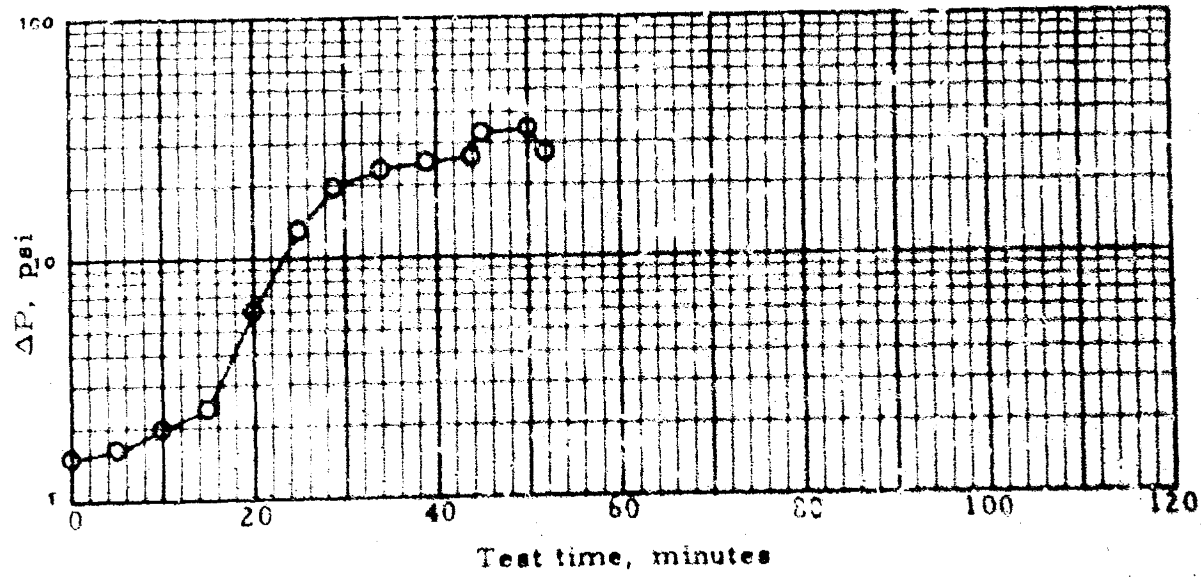


TABLE 178. SINGLE-ELEMENT LOOP TEST NO. 223 Date: 1-August-68

Loop no.	3(Al/SS)	Housing.	8" I.D. Aluminum
		Element:	Filters Inc. X-4208 Lot 465
		Canister:	DoD type 1

Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water.	Fuel inlet temperature, °F	80
Solids:	Coarse AC Dust.	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.02 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , Reused
Date blended with additives: 1-August-68
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Santolene C , Lot NH04006

Test duration, min	54	Calculated dirt loading, g	223
Fuel throughput, gal	1085	Actual element weight gain, g	2[illegible]
Average rate, gpm	20.1		

Time	0 min	End Test
Meter reading, gal	305	1390
Screen ΔP, psi	3	3
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre Test	Post Test	Tank #1
WSIM, distilled water	97	75	83	
IFT, distilled water, dyn/cm	44.3	36.6	36.3	40.6
IFT, inj. water, dyn/cm	44.2	36.0	35.5	40.9

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.3
pH	7.4
ST, dyn/cm	70.8

TABLE 178. SINGLE-ELEMENT LOOP TEST NO. 223 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	1.8	0	0			80
5	2.0	0	0	0.06	0	80
10	2.1	0	0			80
15	2.5	0	0			80
20	3.1	0	0			80
25	5.3	0	0			80
30	10.3	0	0			80
35	20.0	0	0	0.15	3-4	80
40	30.1	0	0	0.01	3-4	80
45	31.5	0	0		3-4	80
50	32.5	0	0		2-3	80
54	40.0	0	0	0.03	3-4	80

Schedule:

Minutes	Water, gpm	Solids, g/min
0-35	0.002	5.72
35-50	0.2	----
50-54	0.2	5.72

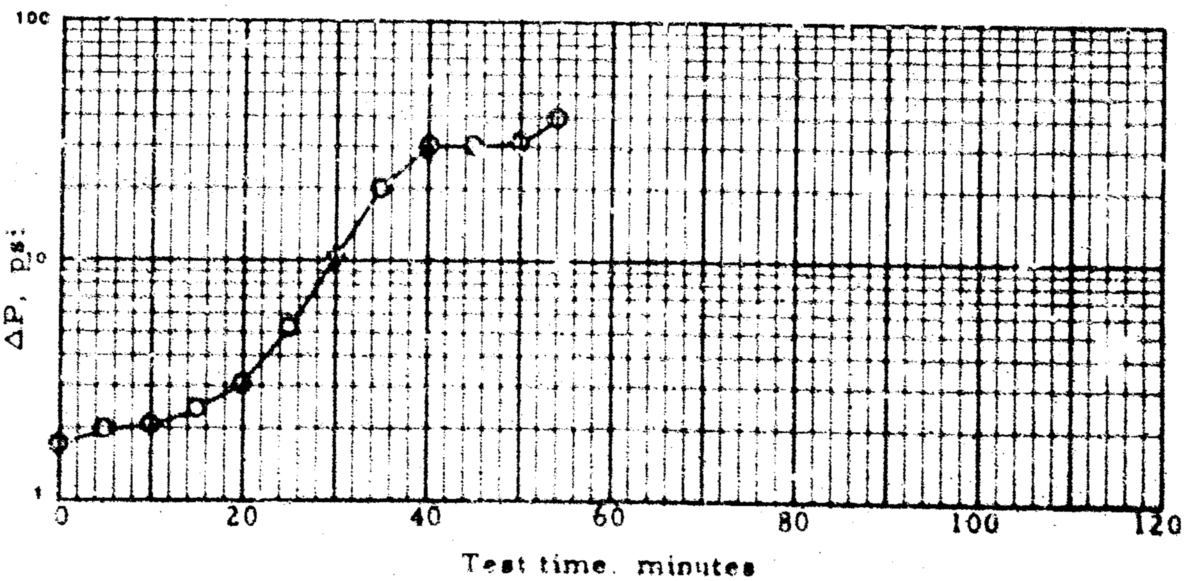


TABLE 179. SINGLE-ELEMENT LOOP TEST NO. 224 Date: 2-August-68

Loop no.	3(Al/SS)	**Housing:**	8" I.D. Aluminum
		Element:	Filters Inc. I-4208
		Canister:	DoD type 1

Procedure no.	13-A	**Fuel flow, gpm**	20
Water:	Filtered tap water.	**Fuel inlet temperature, °F**	80
Solids:	Coarse AC Dust.	**Fuel inlet pressure, psi**	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 ; Reused
Date blended with additives: 2-August-68
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Santolene C , Lot NH04-006

Test duration, min	53	**Calculated dirt loading, g**	217
Fuel throughput, gal	1057	**Actual element weight gain, g**	220
Average rate, gpm	19.9		

Time	0 min	End Test
Meter reading, gal	297	1354
Screen ΔP, psi	3	3
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre Test	Post Test	Tank #1[a]
WSIM, distilled water	93	70	73	
IFT, distilled water, dyn/cm	42.2	36.9	36.0	35.2
IFT, inj. water, dyn/cm	42.7	35.9	35.7	32.8

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.2
pH	7.4
ST, dyn/cm	71.4

a. Hand blend with 0.15% FSII and 16 lb/Mbbl Santolene C.

TABLE 179. SINGLE-ELEMENT LOOP TEST NO. 224 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	1.7	0	0			80
5	2.0	0	0	0.03	0-1	80
10	2.0	0	0			80
15	2.5	0	0			80
20	3.6	0	0			80
25	6.6	0	0			80
30	14.4	0	0			80
33	20.0	0	0	0.07	3-4	80
38	28.6	0	0	0.00	7-8	80
43	29.0	0	0		6-7	80
48	29.0	0	0		10-11	80
50	33.6	0	0			80
53	40.0	0	0	0.04	3-4	80

Schedule:

Minutes	Water, gpm	Solids, g/min
0-33	0.[illegible]2	5.72
33-4[illegible]	0.2	----
4[illegible]-53	[illegible]2	5.72

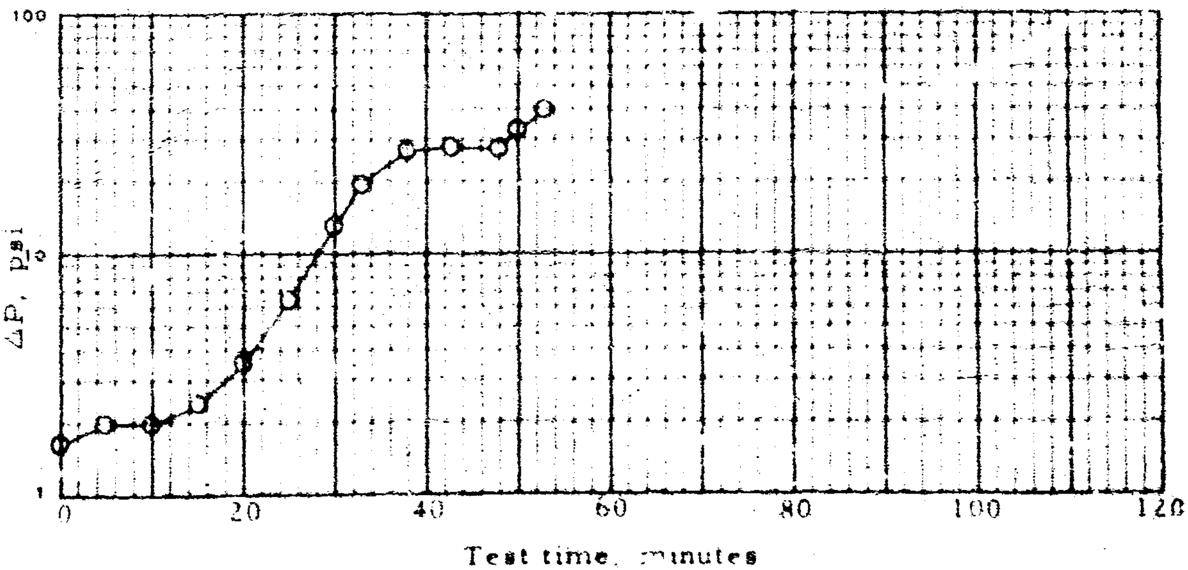


TABLE 180. SINGLE-ELEMENT LOOP TEST NO. 225 Date: 7-August-68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208
Canister: DoD type 1

Procedure no. 13-J
Water: Filtered tap water
Solids: Fine AC Dust.

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , Reused
Date blended with additives: 7-August-68
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Santolene C , Lot NH04-006

Test duration, min 23
Fuel throughput, gal 404
Average rate, gpm 20.6

Calculated dirt loading, g 126
Actual element weight gain, g 123

Time	0 min	End Test
Meter reading, gal	303	777
Screen ΔP, psi	3	3
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre Test	Post Test
WSIM, distilled water	99	68	77
IFT, distilled water, dyn/cm	43.0	36.5	36.4
IFT, inj. water, dyn/cm	41.9	35.9	36.5

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.3
pH	---
ST, dyn/cm	71.0

TABLE 180. SINGLE-ELEMENT LOOP TEST NO. 225 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.1	0	0			
5	2.3	0	0	0.13	0-1	81
10	2.6	0	0			81
15	3.3	0	0			81
20	9.8	0	0			81
22	20.0	0	0	0.16	3-4	81
23	40.0	0	1		8-9	81

Schedule:

Minutes	Water, gpm	Solids, g/min
0-22	0.002	5.72
22-23	0.2	----

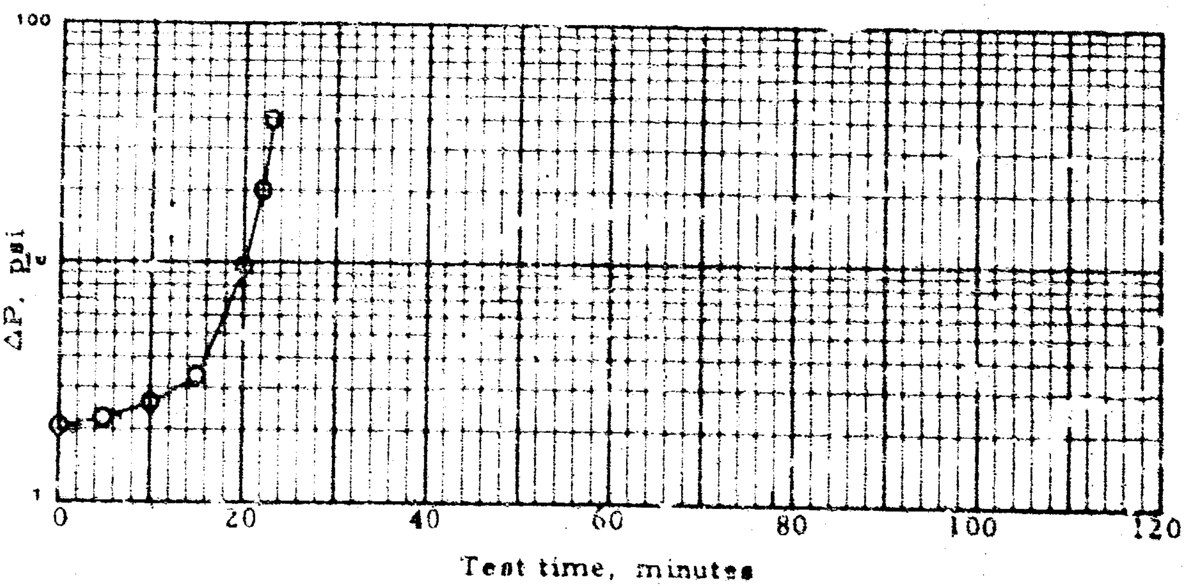


TABLE 181. SINGLE-ELEMENT LOOP TEST NO. 226 Date: 8- August-68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-J
Water: Filtered tap water
Solids: Fine AC Dust

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 Reused
Date blended with additives: 8-August-68
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Santolene C , Lot NH04-006

Test duration, min	39	Calculated dirt loading, g	137
Fuel throughput, gal	778	Actual element weight gain, g	139
Average rate, gpm	19.9		

Time	0 min	End Test
Meter reading, gal	313	1091
Screen ΔP, psi	3	4
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre Test	Post Test
WSIM, distilled water	100	77	83
IFT, distilled water, dyn/cm	42.2	35.2	36.6
IFT, inj. water, dyn/cm	40.5	35.0	35.9

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.1
pH	7.4
ST, dyn/cm	71.2

TABLE 181. SINGLE-ELEMENT LOOP TEST NO. 226 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.0	0	0			80
5	2.4	0	0	0.02	2-3	80
10	2.5	0	0			80
15	4.1	0	0			80
20	12.9	0	0			80
22	20.0	0	0[a]	0.76[b]	2-3	80
27	29.5	0	0	0.04	5-6	80
32	32.0	0	0		10-11	80
37	33.3	0	0		15-16	80
39	40.0	0	0	neg.	16-17	80

a. The initial time of peak started at 20 psi plus 30 sec. into test, and lasted for a period of 20 sec. with a peak value of 3.

b. AC Dust was present on test membrane.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-22	0.002	5.72
22-37	0.2	----
37-39	0.2	5.72

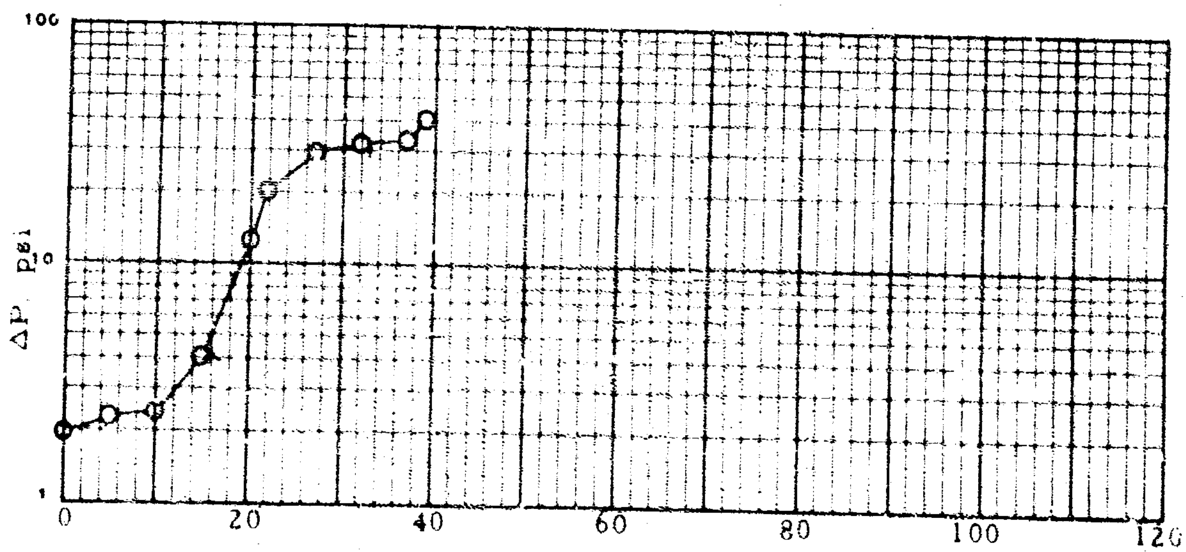


TABLE 182. SINGLE-ELEMENT LOOP TEST NO. 227 Date: 9-August-68

Loop no.	3(Al/SS)	Housing:	8" I.D. Aluminum
		Element:	Filters Inc. I-4208 Lot 465
		Canister:	DoD type 1

Procedure no. 13-J		Fuel flow, gpm	20
Water: Filtered tap water.		Fuel inlet temperature, °F	80
Solids: Fine AC Dust.		Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , Reused
Date blended with additives: 9-August-68
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Santolene C , Lot NH04-006

Test duration, min	25	Calculated dirt loading, g	114
Fuel throughput, gal	501	Actual element weight gain, g	119
Average rate, gpm	20.0		

Time	0 min	End Test
Meter reading, gal	305	806
Screen ΔP, psi	4	4
Cleanup ΔP, psi	2	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre Test	Post Test
WSIM, distilled water	99	75	76
IFT, distilled water, dyn/cm	41.5	36.4	36.3
IFT, inj. water, dyn/cm	39.5	35.4	35.4

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.3
pH	7.8
ST, dyn/cm	70.

TABLE 182. SINGLE-ELEMENT LOOP TEST NO. 227 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.0	0	0			82
5	2.3	0	0	0.04	0-1	82
10	2.6	0	0			82
15	3.8	0	0			82
20	20.0	0	0[a]	0.53[b]	1-2	82
25	39.5	0	0		9-10	82
25	40.0	0	0	neg.	10-11	82

a. A peak value of 3 occurred at 20 psi plus 30 sec.

b. AC Dust was present on test membrane.

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-20	0.002	5.72
	20-25	0.2	----

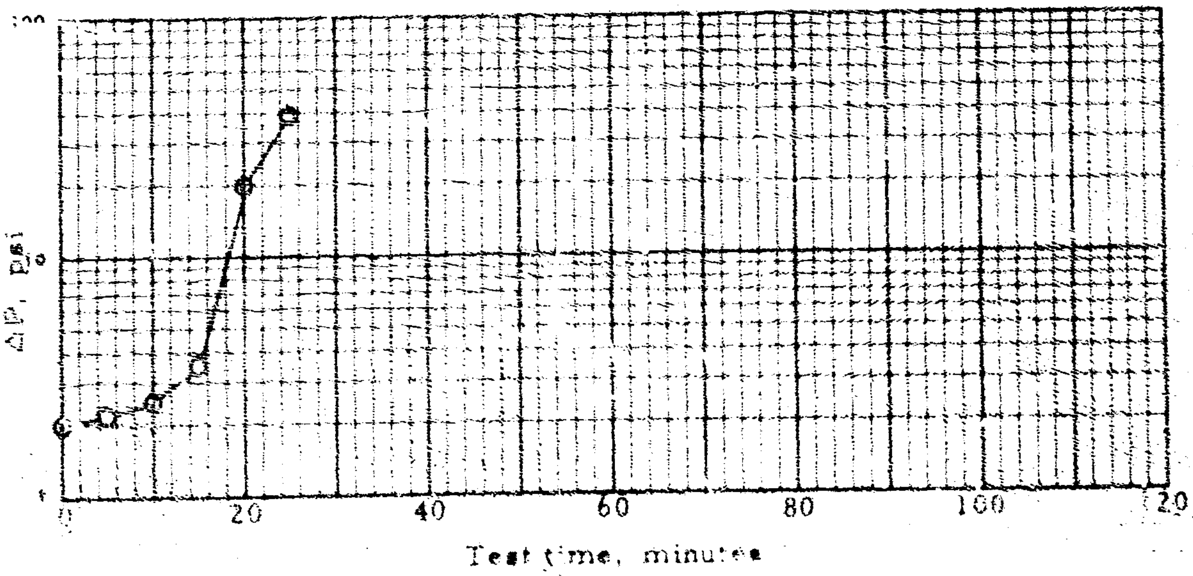


TABLE 183. SINGLE-ELEMENT LOOP TEST NO. 228 Date: 13-August-68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I4208 Lot 465
Canister: DoD type 1

Procedure no. 13-J
Water: Filtered tap water.
Solids: Fine AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , Reused
Date blended with additives: 13-August-68
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Santolene C , Lot NH04-006

Test duration, min	35	Calculated dirt loading, g	120
Fuel throughput, gal	669	Actual element weight gain, g	131
Average rate, gpm	19.7		

Time	0 min	End Test
Meter reading, gal	310	979
Screen ΔP, psi	4	4
Cleanup ΔP, psi	1	2

Analyses on influent fuel:

Time	Post Clay Filter	Pre Test	Post Test
WSIM, distilled water	91	75	62
IFT, distilled water, dyn/cm	41.5	33.4	34.4
IFT, inj. water, dyn/cm	41.0	34.0	32.2

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.4
pH	8.0
ST, dyn/cm	71.2

TABLE 183. SINGLE-ELEMENT LOOP TEST NO. 228 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.0	0	0			80
5	2.0	0	0	neg.	0-1	80
10	2.5	0	0			80
15	3.5	0	0			80
20	16.2	0	0			80
21	20.0	0	1	1.23[a]	6-7	80
26	34.7	0	1	0.03	18-19	80
31	38.6	0	1		8-9	80
35	40.0	0	2	0.11	18-19	80

a. AC Dust was present on membrane.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-21	0.002	5.72
21-35	0.2	----

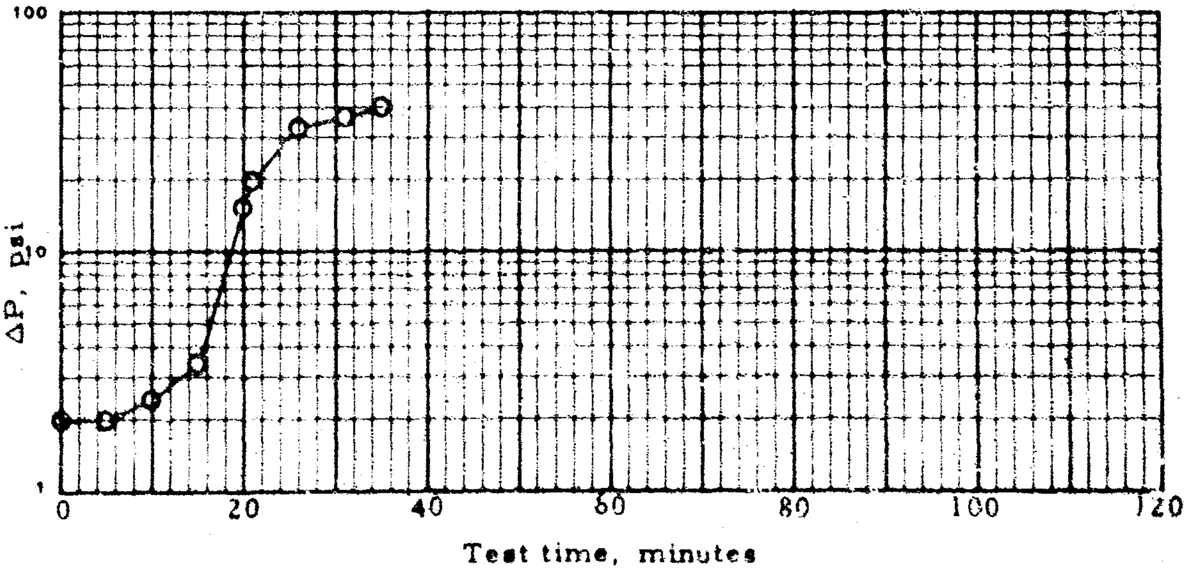


TABLE 184. SINGLE-ELEMENT LOOP TEST NO. 229 Date: 14-August-68

Loop no. 3(A1/SS)	Housing: 8" I.D. Aluminum
	Element: Filters Inc. I-4208 Lot 465
	Canister: DoD type 1

Procedure no.	13-J	Fuel flow, gpm	20
Water:	Filtered tap water	Fuel inlet temperature, °F	80
Solids:	Fine AC Dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , Reused
Date blended with additives: 14-August-68
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Santolene C , Lot NH04-[illegible]

Test duration, min	24	Calculated dirt loading, g	132
Fuel throughput, gal	475	Actual element weight gain, g	135
Average rate gpm	19.8		

Time	0 min	End Test
Meter reading, gal	308	783
Screen ΔP, psi	1	1
Cleanup ΔP, psi	2	1

Analyses on influent fuel:			
Time	Post Clay Filter	Pre Test	Post Test
WSIM, distilled water	97	[illegible]	[illegible]
IFT, distilled water, dyn/cm	41.1	[illegible]	34.
IFT, inj. water, dyn/cm	39.9	[illegible]	33.[illegible]

Analyses on injection water:	
Time	Post Test
Solids, mg/liter	[illegible]
pH	7.[illegible]
ST, dyn/cm	71.

TABLE 184. SINGLE-ELEMENT LOOP TEST NO. 229 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.1	0	0			85
5	2.1	1	0	neg.[a]	2-3	85
10	2.5	1	0	0.09[a]	0[a]	85
15	3.0	2	0			84
20	10.0	2	0			85
23	20.0	2	0	0.17	4-5	84
24	40.0	2	1		16-17	84

a. Special sample, from clean-influent sample port, taken because of the positive readings being given by the influent Totamitor.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-23	0.002	5.72
23-24	0.2	----

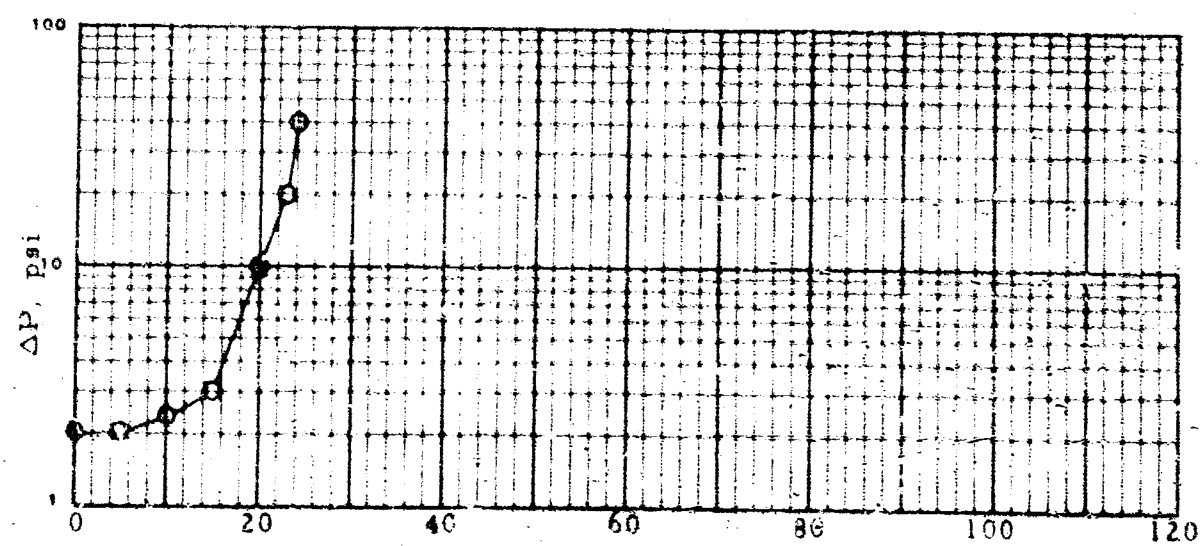


TABLE 185. SINGLE-ELEMENT LOOP TEST NO. 230 Date: 16-August-68

Loop no.	3(Al/SS)	Housing:	8" I.D. Aluminum
		Element:	Filters Inc. I-4208 Lot 465
		Canister:	DoD type 1

Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water.	Fuel inlet temperature, °F	80
Solids:	Coarse AC Dust.	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , Reused
Date blended with additives: 16-August-68
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min	46	Calculated dirt loading, g	177
Fuel throughput, gal	920	Actual element weight gain, g	194
Average rate, gpm	20.0		

Time	0 min	End Test
Meter reading, gal	300	1220
Screen ΔP, psi	4	4
Cleanup ΔP, psi	0	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre Test	Post Test
WSIM, distilled water	93	63	80
IFT, distilled water, dyn/cm	40.0	23.1	23.4

Analyses on injection water:

Time	Post Test
Solids, mg/liter	NEG.
pH	7.5
ST, dyn/cm	73.0

TABLE 185. SINGLE-ELEMENT LOOP TEST NO. 230 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.4	0	0			80
5	2.4	0	0	0.14	1-2	80
10	3.0	0	0			80
15	4.2	0	0			80
20	7.4	0	0			80
25	14.5	0	0			80
28	20.0	0	0	0.10	3-4	80
33	29.2	0	1	neg.	5-6	81
38	31.6	0	0		7-8	81
43	31.6	0	0		7-8	81
46	40.0	0	0	neg.	17-18	81

Schedule:

Minutes	Water, gpm	Solids, g/min
0-28	0.002	5.72
28-43	0.2	----
43-46	0.2	5.72

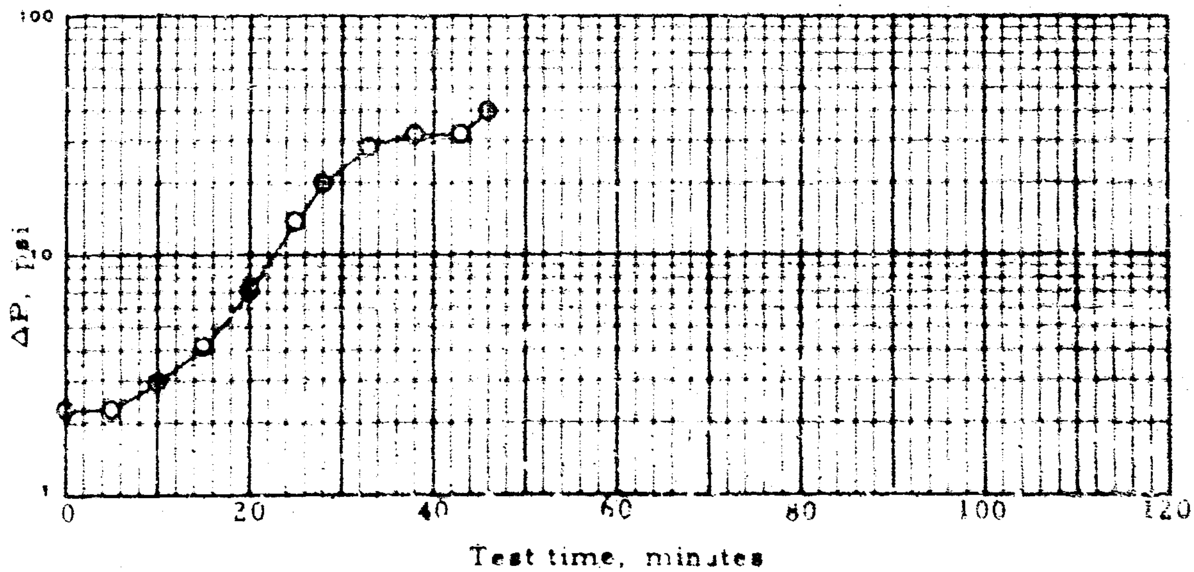


TABLE 186. SINGLE-ELEMENT LOOP TEST NO. 231 Date: 19-August-68

Loop no.	3(Al/SS)	Housing: 8" I.D. Aluminum	
		Element: Filters Inc. I-4208 Lot 465	
		Canister: DoD type 1	
Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water.	Fuel inlet temperature, °F	80
Solids:	Coarse AC DUST.	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , Reused
Date blended with additives: 19-August-68
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min	50	Calculated dirt loading, g	200
Fuel throughput, gal	999	Actual element weight gain, g	182
Average rate, gpm	20.0		

Time	0 min	End Test
Meter reading, gal	300	1299
Screen ΔP, psi	4	4
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre Test	Post Test
WSIM, distilled water	93	74	72
IFT, distilled water, dyn/cm	42.4	23.8	23.4

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.0
pH	7.8
ST, dyn/cm	72.6

TABLE 186. SINGLE-ELEMENT LOOP TEST NO. 231 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	1.8	0	0			80
5	2.0	0	0	0.19	0-1	80
10	2.0	0	0			80
15	2.4	0	0			80
20	3.1	0	0			80
25	6.0	0	0			80
30	15.0	0	0			80
32	20.0	0	0	0.20	3-4	80
37	25.9	0	0	0.09	3-4	80
42	28.2	0	0		2-3	80
47	29.7	0	0		7-8	81
50	40.0	0	0	0.09	16-17	81

Schedule:

Minutes	Water, gpm	Solids, g/min
0-32	0.002	5.72
32-47	0.2	----
47-50	0.2	5.72

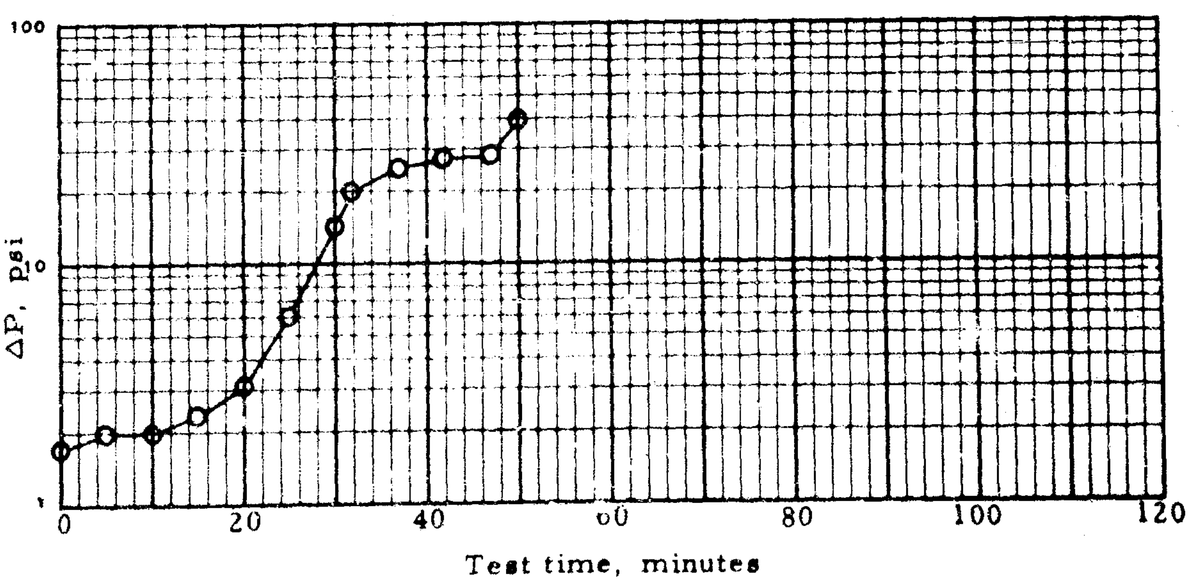


TABLE 187. SINGLE-ELEMENT LOOP TEST NO. 232 Date: 20-August-68

Loop no. 3(Al/SS)

Housing: 8" I.D. ALuminum
Element: Filters Inc. I-4208 Lot 465
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm 20
Fuel inlet temperature, °F 80
Fuel inlet pressure, psi 70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , Reused
Date blended with additives: 20-August-68
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min 58
Fuel throughput, gal 1170
Average rate, gpm 20.0

Calculated dirt loading, g 252
Actual element weight gain, g 238

Time	0 min	End Test
Meter reading, gal	300	1470
Screen ΔP, psi	4	4
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre Test	Post Test
WSIM, distilled water	94	74	76
IFT, distilled water, dyn/cm	42.5	23.7	23.6

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.0
pH	7.6
ST, dyn/cm	72.0

TABLE 187 SINGLE-ELEMENT LOOP TEST NO. 232 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	1.9	0	0			80
5	1.9	0	0	0.10	1-2	80
10	2.1	0	0			80
15	2.4	0	0			80
20	2.6	0	0			81
25	3.5	0	0			81
30	4.7	0	0			81
35	8.5	0	0			81
40	16.5	0	0			81
42	20.0	0	0	0.16	8-9	81
47	28.0	0	1	0.03	14-15	82
52	29.5	0	0		13-14	83
57	32.5	0	0		17-18	83
58	40.0	0	1	0.05	17-18	83

Schedule:

Minutes	Water, gpm	Solids, g/min
0-42	0.002	5.72
42-57	0.2	----
57-58	0.2	5.72

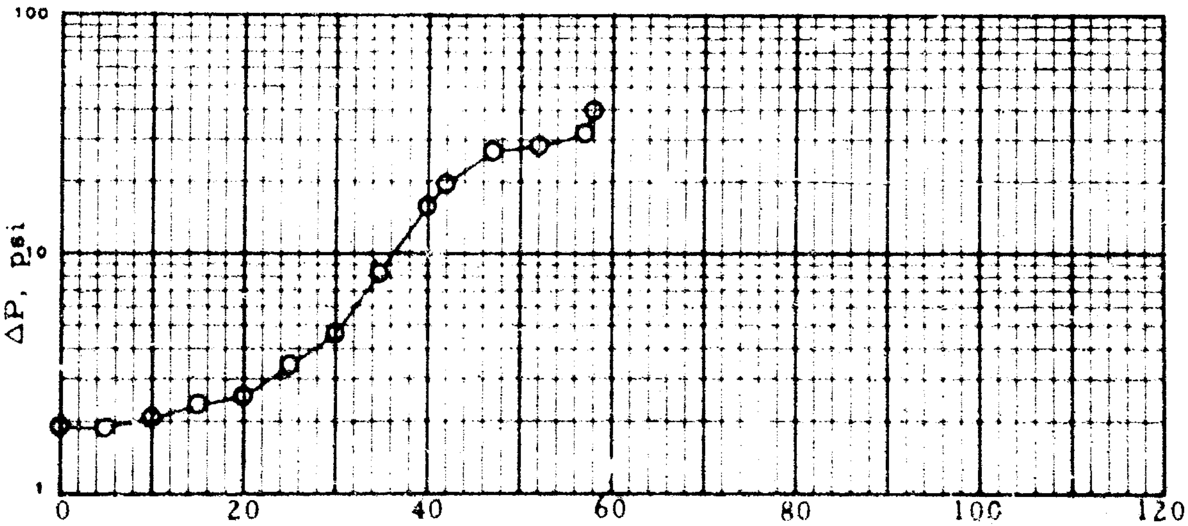


TABLE 188. SINGLE-ELEMENT LOOP TEST NO. 233 Date: 21-August-68

Loop no.	3(Al/SS)	Housing:	3" I.D. Aluminum
		Element:	Filters Inc. I-4208 Lot 465
		Canister:	DoD type 1
Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered tap water.	Fuel inlet temperature, °F	80
Solids:	Coarse AC Dust.	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , Reused
Date blended with additives: 21-August-68
Anti-icing additive 0.15 vol. %, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min	55	Calculated dirt loading, g	229
Fuel throughput, gal	1105	Actual element weight gain, g	228
Average rate, gpm	20.1		

Time	0 min	End Test
Meter reading, gal	300	1405
Screen ΔP, psi	4	4
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre Test	Post Test
WSIM, distilled water	96	76	72
IFT, distilled water, dyn/cm	41.8	24.0	24.7

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.5
pH	7.4
ST, dyn/cm	72.4

TABLE 188. SINGLE-ELEMENT LOOP TEST NO. 233 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	1.6	0	0			80
5	1 6	0	1	0 18	1-2	80
10	1.7	0	1			81
15	1.9	0	1			81
20	2.1	0	1			81
25	3.0	0	1			81
30	5.5	0	1			81
35	11.8	0	1			81
39	20.0	0	1	0.50[a]	6-7	81
44	28.6	0	1	0.05	16-17	82
49	31.3	0	1		16-17	82
54	33.0	0	1		18-19	82
55	40.0	0	1	0.03	17-18	83

a. AC Dust was present on test membrane.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-39	0.002	5.72
39-54	0.2	----
54-55	0.2	5.72

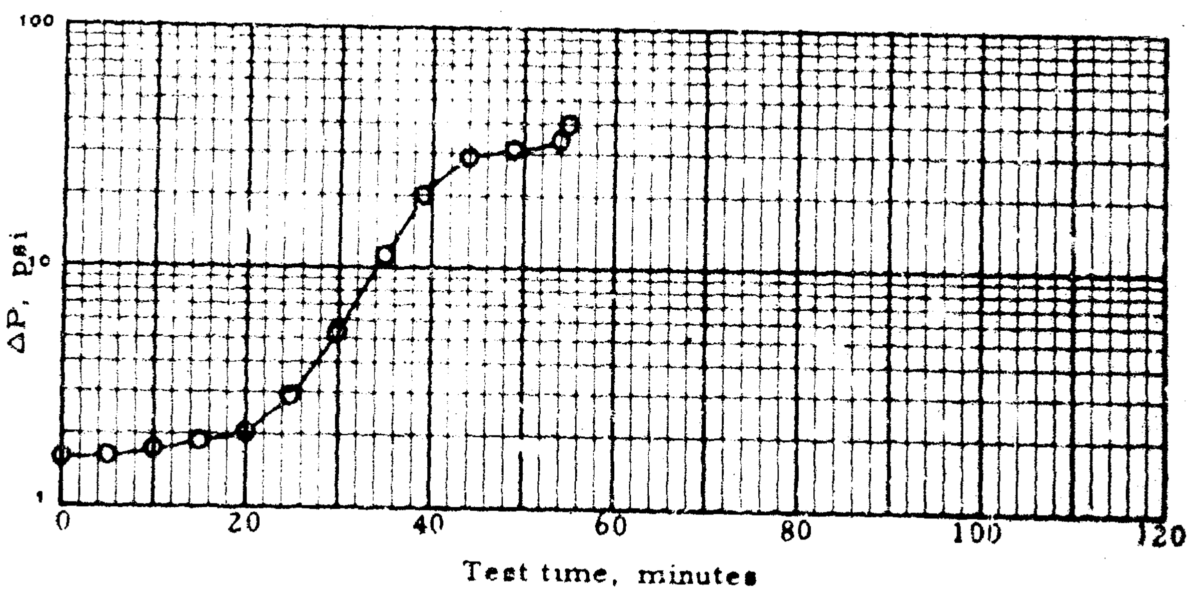


TABLE 189. SINGLE-ELEMENT LOOP TEST NO. 234 Date: 22-August-68

Loop no. 3(Al/SS)

Housing: 8" I.D. Aluminum
Element: Filters Inc. I-4208
Canister: DoD type 1

Procedure no. 13-A
Water: Filtered tap water.
Solids: Coarse AC Dust.

Fuel flow, gpm	20
Fuel inlet temperature, °F	80
Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinued 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , Reused
Date blended with additives: 22-August-68
Anti-icing additive 0.15 vol.%, Dow, Lot 03187126
Corrosion inhibitor 16 lb/Mbbl, Du Pont AFA-1 , Lot 37

Test duration, min	52	Calculated dirt loading, g	212
Fuel throughput, gal	1048	Actual element weight gain, g	214
Average rate, gpm	20.2		

Time	0 min.	End Test
Meter reading, gal	300	1348
Screen ΔP, psi	4	4
Cleanup ΔP, psi	1	1

Analyses on influent fuel:			
Time	Post Clay Filter	Pre Test	Post Test
WSIM, distilled water	97	72	75
IFT, distilled water, dyn/cm	43.6	24.2	24.3

Analyses on injection water:	
Time	Post Test
Solids, mg/liter	0.0
pH	7.5
ST, dyn/cm	71.9

TABLE 189. SINGLE-ELEMENT LOOP TEST NO. 234 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	1.8	0	0			80
5	1.9	0	0	0.12	5[a]	80
10	2.0	0	0			80
15	2.3	0	0			81
17	2.5	0	0		5[a]	81
20	2.9	0	0			81
25	4.9	0	0			81
30	8.9	0	0			81
35	17.0	0	0[b]			81
36	20.0	0	0	0.11	8-9	81
41	29.3	0	0	0.04	16-17	81
46	32.5	0	0		16-17	82
51	34.4	0	0		17-18	82
52	40.0	0	0	0.00	19-20	82

a. The free water pads were hard to rate. The overall distribution was 3-6.

b. The initial time of the peak started at 20 psi plus 30 sec into the test and lasted for a period of 1 minute plus 30 sec. A peak value of 1 occurred at 20 psi plus 40 sec.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-36	0.002	5.72
36-51	0.2	----
51-52	0.2	5.72

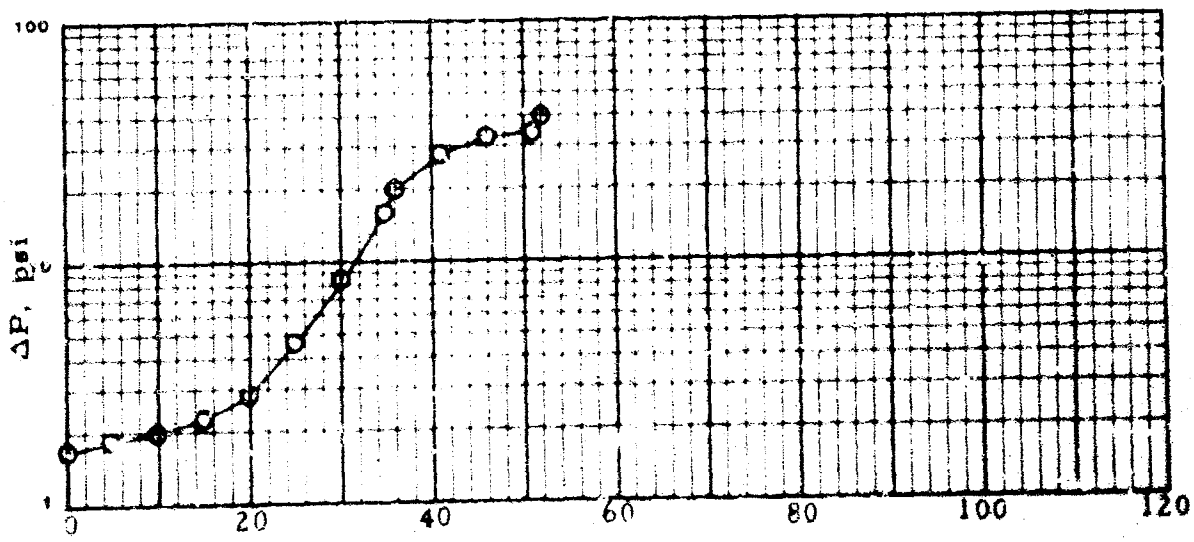


TABLE 190. SINGLE-ELEMENT LOOP TEST NO. 235 Date: 1[illegible]-Sept-68

Loop no.	3(Al/SS)	Housing:	8" ID Aluminum
		Element:	Filters Inc. I 4208 Lot 465
		Canister:	DoD type 1

Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered Tap Water	Fuel inlet temperature, °F	80
Solids:	Coarse AC Dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinue 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , reused, clay-treated
Date blended with additives: 18-Sept-68
Anti-icing additive 0.15 vol. %, Dow, Lot 0226816
Corrosion inhibitor 20 lb/Mbbl, Du Pont RP-2 , Lot 333

Test duration, min	56	Calculated dirt loading, g	234
Fuel throughput, gal	1120	Actual element weight gain, g	242
Average rate, gpm	20.0		

Time	0 min	End Test
Meter reading, gal	300	1420
Screen ΔP, psi	4	4
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre-Test	Post Test
WSIM, distilled water	97	60	6[illegible]
IFT, distilled water, dyn/cm	41.5	27.3	[illegible]

Analyses on injection water:

Time	Post Test
Solids, mg/liter	[illegible]
pH	[illegible]
ST, dyn/cm	71.[illegible]

TABLE 190. SINGLE-ELEMENT LOOP TEST NO. 235 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	1.6	0	0			80
5	1.6	0	0	0.14[a]	0-1	80
10	1.9	0	0			80
15	2.0	0	0			80
20	2.6	0	0			80
25	3.1	0	0			80
30	4.4	0	0			80
35	8.5	0	0[b]			80
40	20.0	0	0	0.23	6-7	80
45	28.5	0	6	0.13	18-19	80
50	31.2	0	6		19-20	80
55	33.0	0	13		20 +++	80
56	40.0	0	22	0.15[a]	20 +++	80

a. AC Dust was present on membrane.

b. The initial time of the increase in Totamitor began at 20 psi plus 40 sec and continued to rise for the remainder of the test.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-40	.002	5.72
40-55	0.2	----
55-56	0.2	5.72

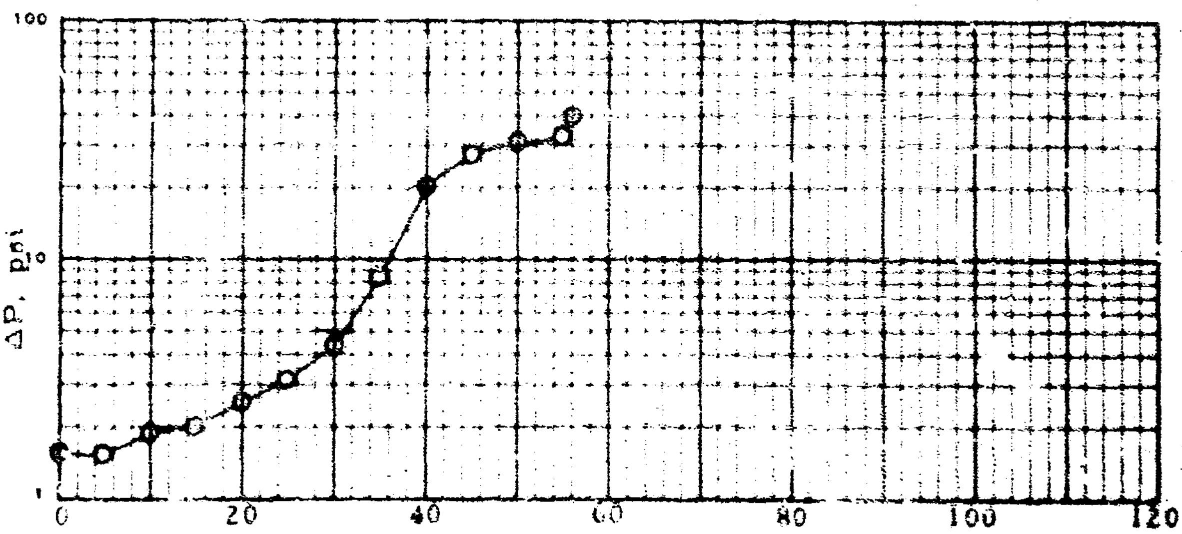


TABLE 191. SINGLE-ELEMENT LOOP TEST NO. 236 Date: 19-Sept-68

Loop no.	3(Al/SS)	Housing:	8" ID Aluminum
		Element:	Filters Inc. I 4208 Lot 465
		Canister:	DoD type 1

Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered Tap Water	Fuel inlet temperature, °F	80
Solids:	Coarse AC Dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinue 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , reused, clay-treated
Date blended with additives: 19-Sept-68
Anti-icing additive 0.15 vol. %, Dow, Lot 0226816
Corrosion inhibitor 20 lb/Mbbl, Du Pont RP-2 , Lot 333

Test duration, min	45	Calculated dirt loading, g	172
Fuel throughput, gal	900	Actual element weight gain, g	167
Average rate, gpm	20.0		

Time	0 min	End Test
Meter reading, gal	300	1200
Screen ΔP, psi	4	4
Cleanup ΔP, psi	2	2

Analyses on influent fuel:

Time	Post Clay Filter	Pre-Test	Post Test
WSIM, distilled water	96	54	64
IFT, distilled water, dyn/cm	38.6	25.4	25.1

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.0
pH	7.4
ST, dyn/cm	72.8

TABLE 191. SINGLE-ELEMENT LOOP TEST NO. 236 (Cont'd)

Time, min	ΔP, psi	Totamitor		Effluent, mg/liter		Influent fuel temperature, °F
		Infl.	Effl.	Solids	Free water	
0	1.8	0	0			80
5	1.8	0	0	0.12[a]	2-3	80
10	2.0	0	0			80
15	2.3	0	0			80
20	3.3	0	1		4-5	80
25	11.1	0	1			80
28	20.0	0	1[c]	0.43[a]	6-7	80
30	24.1	0	2		4-5	80
33	24.8	0	1	0.01	11-12	80
38	28.0	0	1		9-10	80
43	30.3	0	1		b	80
45	40.0	0	1	0.04	17-18	80

a. AC Dust was present on test membrane.
b. sample inadvertently lost
c. The initial time of the peak started at 21 min test time.
A peak of 2 occurred at 20 psi plus 35 sec.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-28	0.002	5.72
28-43	0.2	----
43-45	0.2	5.72

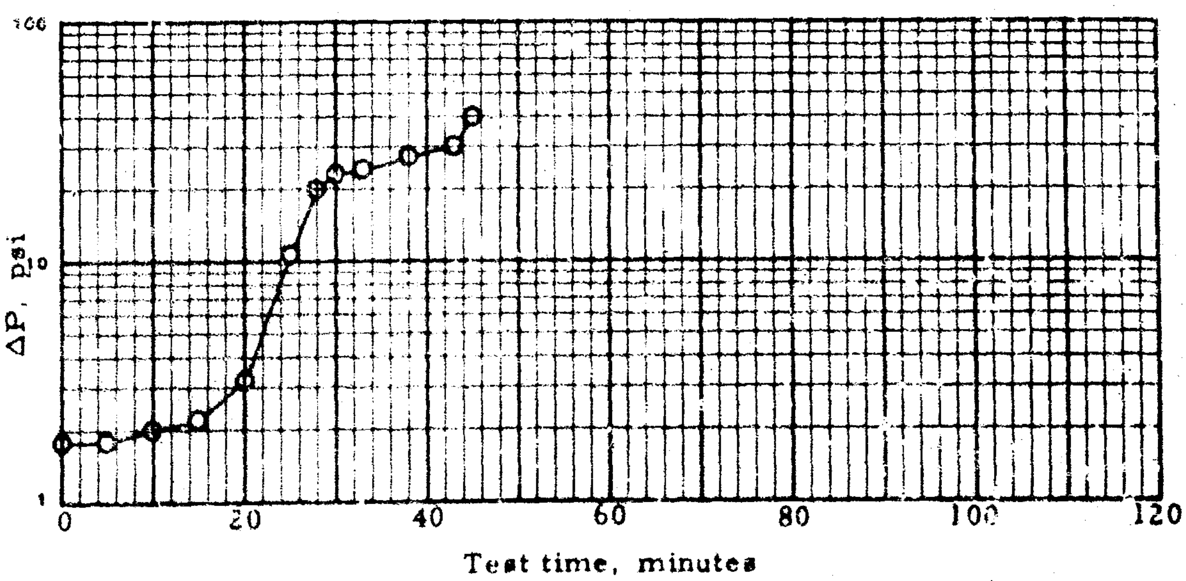


TABLE 192. SINGLE-ELEMENT LOOP TEST NO. 237 Date: 23-Sept-68

Loop no.	3(Al/SS)	Housing:	8" ID Aluminum
		Element:	Filters Inc. I 4208 Lot 465
		Canister:	DoD type 1
Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered Tap Water	Fuel inlet temperature, °F	80
Solids:	Coarse AC Dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinue 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , reused, clay-treated
Date blended with additives: 23-Sept-68
Anti-icing additive 0.15 vol. %, Dow, Lot 0226816
Corrosion inhibitor 20 lb/Mbbl, Du Pont RP-2 , Lot 333

Test duration, min	48	Calculated dirt loading, g	189
Fuel throughput, gal	962	Actual element weight gain, g	188
Average rate, gpm	20.0		

Time	0 min	End Test
Meter reading, gal	300	1262
Screen ΔP, psi	4	4
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre-Test	Post Test[a]
WSIM, distilled water	92	57	70
IFT, distilled water, dyn/cm	37.4	25.5	24.5

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.0
pH	7.5
ST, dyn/cm	72.6

a. Clay treatment of the fuel did not increase the IFT sufficiently; values of 33.7 dynes/cm and a WSIM value of 93 were obtained. The clay filters were removed after this test and new filters installed. Analysis of a sample from underground storage (no clay treatment) after test 237 gave a WSIM value of 90 and an IFT value of 41.6 dynes/cm.

TABLE 192. SINGLE-ELEMENT LOOP TEST NO. 237 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.6	0	0			
5	2.6	0	0	0.19	20	80
10	2.9	0	0		16-17	80
15	3.6	0	0		13-14	80
20	4.8	0	0	0.08	8-9	80
25	7.0	0	0		10-11	80
30	15.0	0	0			80
32	20.0	0	0[a]	0.16	10-11	80
37	29.3	0	0	0.09	12-13	80
42	31.6	0	0		6-7	80
47	33.6	0	0		9-10	80
48	40.0	0	0	0.08	19-20	80

a. A peak value of 1 occurred at 20 psi plus 45 sec.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-32	0.002	5.72
32-47	0.2	----
47-48	0.2	5.72

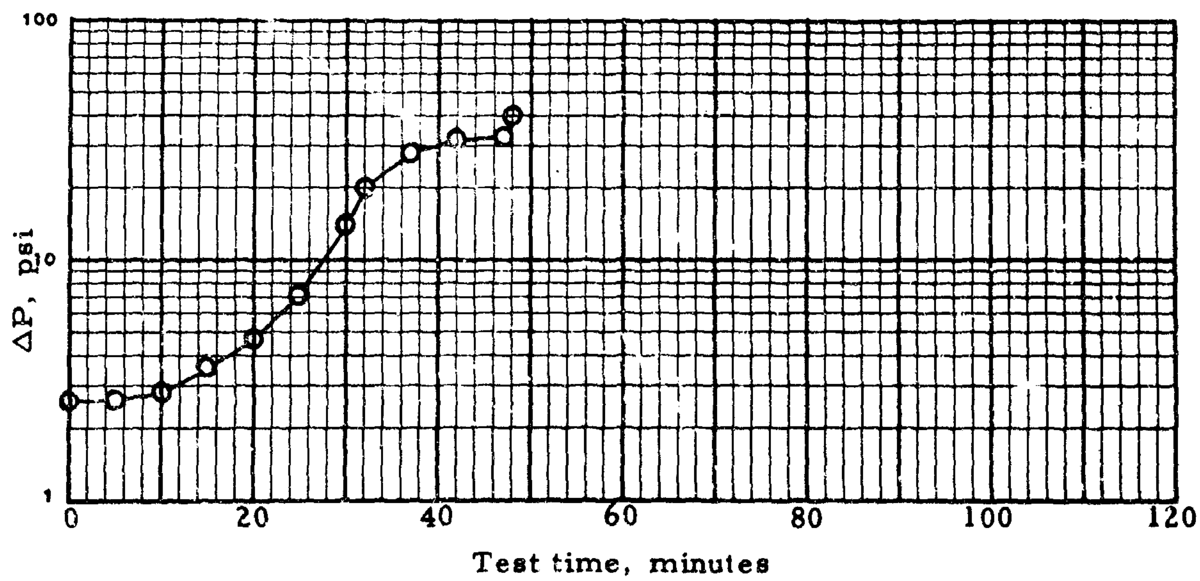


TABLE 193. SINGLE-ELEMENT LOOP TEST NO. 238 Date: 25-Sept-68

Loop no.	3(Al/SS)	Housing:	8" ID Aluminum
		Element:	Filters Inc. I 4208 Lot 465
		Canister:	DoD type 1

Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered Tap Water	Fuel inlet temperature, °F	80
Solids:	Coarse AC Dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinue 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , reused, clay-treated
Date blended with additives: 25-Sept-68
Anti-icing additive 0.15 vol.%, Dow, Lot 0226816
Corrosion inhibitor 20 lb/Mbbl, Du Pont RP-2 , Lot 333

Test duration, min	64	Calculated dirt loading, g	280
Fuel throughput, gal	1277	Actual element weight gain, g	279
Average rate, gpm	20.0		

Time	0 min	End Test
Meter reading, gal	300	1577
Screen ΔP, psi	4	4
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre-Test	Post Test
WSIM, distilled water	96	72	72
IFT, distilled water, dyn/cm	43.5	27.6	28.1

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.4
pH	7.5
ST, dyn/cm	72.2

TABLE 193. SINGLE-ELEMENT LOOP TEST NO. 238 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	1.6	0	0			80
5	1.8	0	0	0.17[a]	2-3	80
10	1.9	0	0			80
15	2.0	0	0			80
20	2.2	0	0			80
25	2.7	0	0			80
30	3.6	0	0			80
35	5.2	0	0			80
40	8.3	0	0			80
45	14.5	0	0			80
47	20.0	0	0[b]	0.44[a]	2-3	80
52	28.2	0	0	0.12	11-12	80
57	29.8	0	0		17-18	80
62	31.5	0	0		10-11	80
64	40.0	0	0	0.24	18-19	80

a. AC Dust was present on the test membrane.

b. The initial time of the peak started at 20 psi plus 20 sec into the test and lasted for a period of 5 min. A peak value of 2 occurred at 20 psi plus 40 sec. Another peak occurred at 20 psi plus 13 min with a peak value of 1.

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-47	0.002	5.72
	47-62	0.2	----
	62-64	0.2	5.72

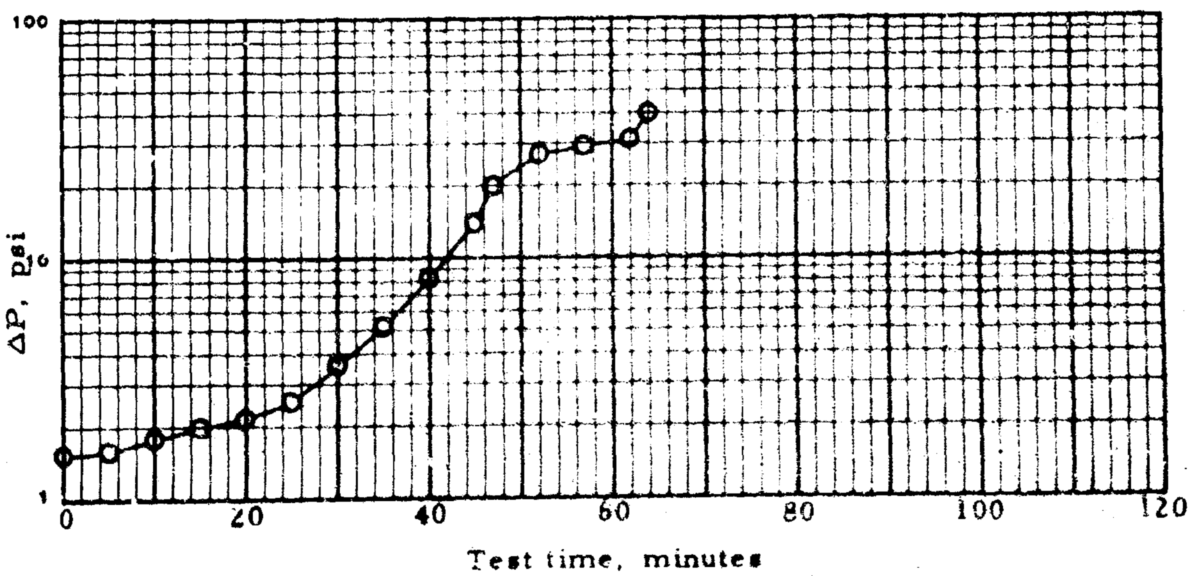


TABLE 194. SINGLE-ELEMENT LOOP TEST NO. 239 Date: 26-Sept-68

Loop no.	3(Al/SS)	**Housing:**	8" ID Aluminum
		Element:	Filters Inc. I 4208 Lot 465
		Canister:	DoD type 1
Procedure no.	13 A	**Fuel flow, gpm**	20
Water:	Filtered Tap Water	**Fuel inlet temperature, °F**	80
Solids:	Coarse AC Dust	**Fuel inlet pressure, psi**	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinue 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , reused, clay-treated
Date blended with additives: 26-Sept-68
Anti-icing additive 0.15 vol.%, Dow, Lot 0226816
Corrosion inhibitor 20 lb/Mbbl, Du Pont RP-2 , Lot 333

Test duration, min	77	**Calculated dirt loading, g**	355
Fuel throughput, gal	1532	**Actual element weight gain, g**	343
Average rate, gpm	19.9		

Time	0 min	End Test
Meter reading, gal	300	1832
Screen ΔP, psi	4	4
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre-Test	Post Test
WSIM, distilled water	94	72	54
IFT, distilled water, dyn/cm	42.9	26.0	27.0

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.0
pH	7.6
ST, dyn/cm	73.0

TABLE 194. SINGLE-ELEMENT LOOP TEST NO. 239 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	1.6	0	0			80
5	1.8	0	0	0.16	3-4	80
10	1.9	0	0			80
15	2.1	0	0			80
20	2.4	0	0			80
25	2.5	0	0			80
30	2.9	0	0			80
35	3.4	0	0			80
40	4.5	0	0			80
45	5.9	0	0			80
50	8.6	0	0			80
55	14.3	0	0			80
58	20.0	0	0	0.33[a]	12-13	80
62	b	0	b	0.11	15-16	80
63	16.0	0	1	0.43[a]	6-7	80
68	19.8	0	0		12-13	80
73	21.5	0	0		14-15	80
77	40.0	0	0	0.14	8-9	80

a. AC Dust was present on the test membrane.
b. At 20 psi plus 4 min, the pressure drop decreased from a reading of 30 psi to 15 psi. A Totamitor peak occurred at this point with a value of 2.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-58	0.002	5.72
58-73	0.2	----
73-77	0.2	5.72

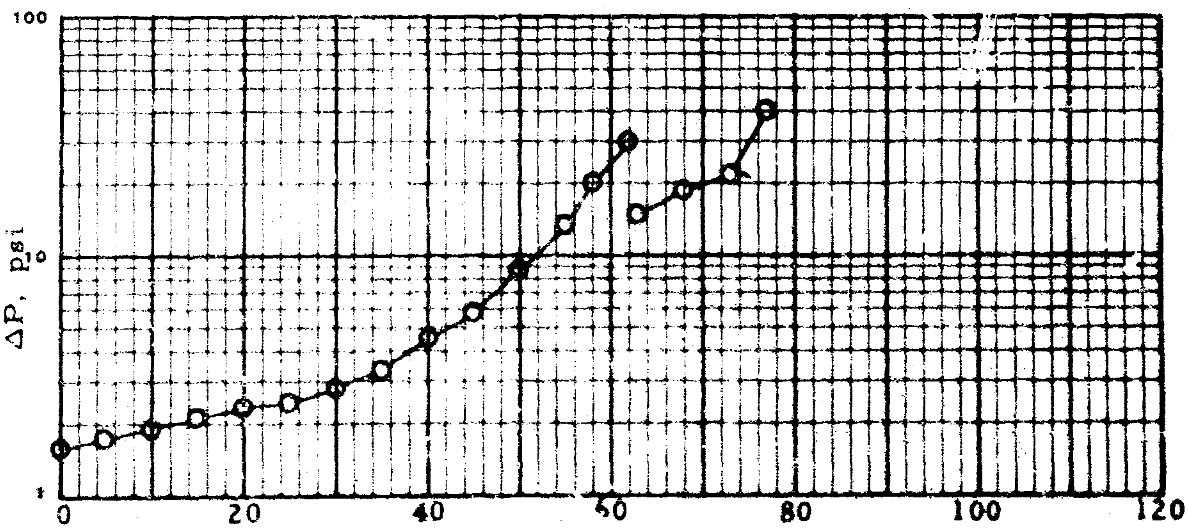


TABLE 195. SINGLE-ELEMENT LOOP TEST NO. 240 Date: 27-Sept-68

Loop no.	3(Al/SS)	Housing:	8" ID Aluminum
		Element:	Filters Inc. I 4208 Lot 465
		Canister:	DoD type 1
Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered Tap Water	Fuel inlet temperature, °F	80
Solids:	Coarse AC Dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinue 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , reused, clay-treated
Date blended with additives: 27-Sept-68
Anti-icing additive 0.15 vol. %, Dow, Lot 0226816
Corrosion inhibitor 20 lb/Mbbl, Du Pont RP -2 , Lot 333

Test duration, min	56	Calculated dirt loading, g	234
Fuel throughput, gal	1113	Actual element weight gain, g	232
Average rate, gpm	19.9		

Time	0 min	End Test
Meter reading, gal	300	1413
Screen ΔP, psi	4	4
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre-Test	Post Test
WSIM, distilled water	96	81	88
IFT, distilled water, dyn/cm	43.0	27.4	28.0

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.2
pH	7.7
ST, dyn/cm	72.0

TABLE 195. SINGLE-ELEMENT LOOP TEST NO. 240 (Cont'd)

Time, min	ΔP, psi	Totamitor		Effluent, mg/liter		Influent fuel temperature, °F
		Infl.	Effl.	Solids	Free water	
0	1.7	0	0			80
5	1.9	0	0	0.20	11-12	80
10	2.0	0	0			80
15	2.1	0	0		3-4	80
20	2.4	0	0			80
25	3.0	0	0			80
30	4.1	0	0			80
35	7.6	0	0			80
40	20.0	0	0[a]	0.33[b]	6-7	80
45	31.6	0	0	0.04	8-9	80
50	33.5	0	0		5-6	80
55	35.5	0	0		15-16	80
56	40.0	0	0	0.08	18-19	80

a. A peak value of 1 occurred at 20 psi plus 45 sec.
b. AC Dust was present on test membrane.

Schedule:	Minutes	Water, gpm	Solids, g/min
	0-40	0.002	5.72
	40-55	0.2	----
	55-56	0.2	5.72

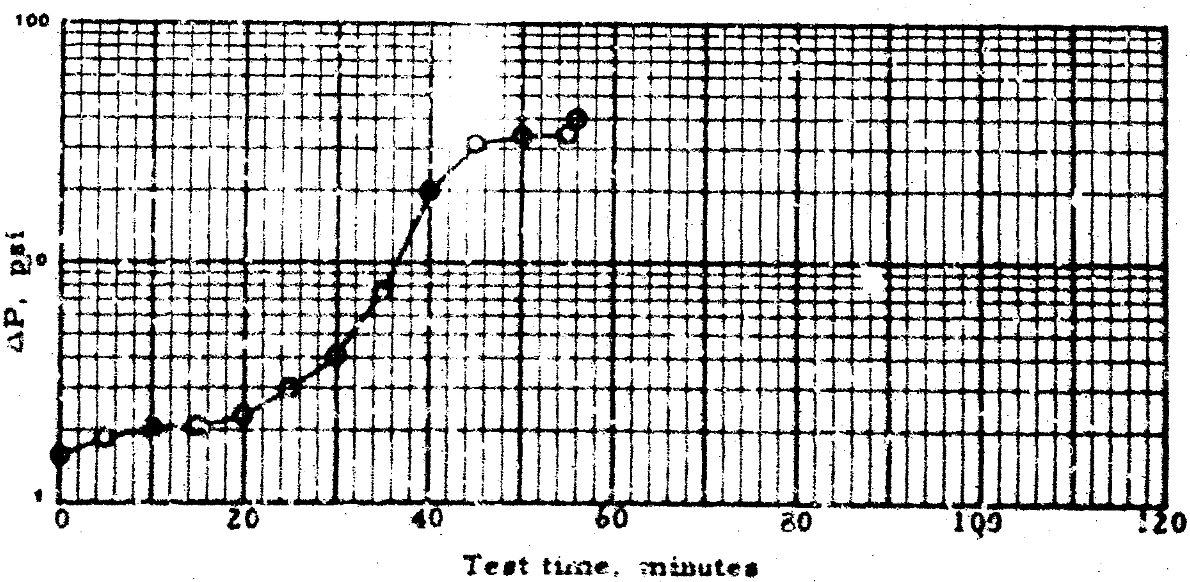


TABLE 196. SINGLE-ELEMENT LOOP TEST NO. 241 Date: 1-Oct-68

Loop no.	3(Al/SS)	Housing:	8" ID Aluminum
		Element:	Filters Inc. I 4208 Lot 465
		Canister:	DoD type 1
Procedure no.	13-A	Fuel flow, gpm	20
Water:	filtered Tap Water	Fuel inlet temperature, °F	80
Solids:	Coarse AC Dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinue 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , reused, clay-treated
Date blended with additives: 1-Oct-68
Anti-icing additive 0.15 vol. %, Dow, Lot 0226816
Corrosion inhibitor 20 lb/Mbbl, Du Pont RP-2 , Lot 333

Test duration, min	41	Calculated dirt loading, g	149
Fuel throughput, gal	823	Actual element weight gain, g	155
Average rate, gpm	20.1		

Time	0 min	End Test
Meter reading, gal	301	1124
Screen ΔP, psi	4	3
Cleanup ΔP, psi	2	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre-Test	Post Test
WSIM, distilled water	97	57	62
IFT, distilled water, dyn/cm	43.7	28.7	28.6

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.1
pH	7.9
ST, dyn/cm	72.6

TABLE 196. SINGLE-ELEMENT LOOP TEST NO. 241 (Cont'd)

Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.2	0	0			80
5	2.4	0	0	0.20	4-6[a]	80
10	2.6	0	0			80
15	3.5	0	0			80
20	5.6	0	0			80
25	18.5	0	0			80
26	20.0	0	0[b]	0.40	5-6[a]	80
31	31.8	0	8	0.10	20+	80
36	34.8	0	10	0.16	20+	80
41	36.3	0	11		20+	80
41	40.0	0	12	0.17	20+++	80

a. The free water detector pads were hard to rate due to very fine dispersion of water droplets.

b. The initial time of the peak started at 20psi plus 30 sec. The peak value occurred at 40 psi.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-26	0.002	5.72
26-41	0.2	----
41-41	0.2	5.72

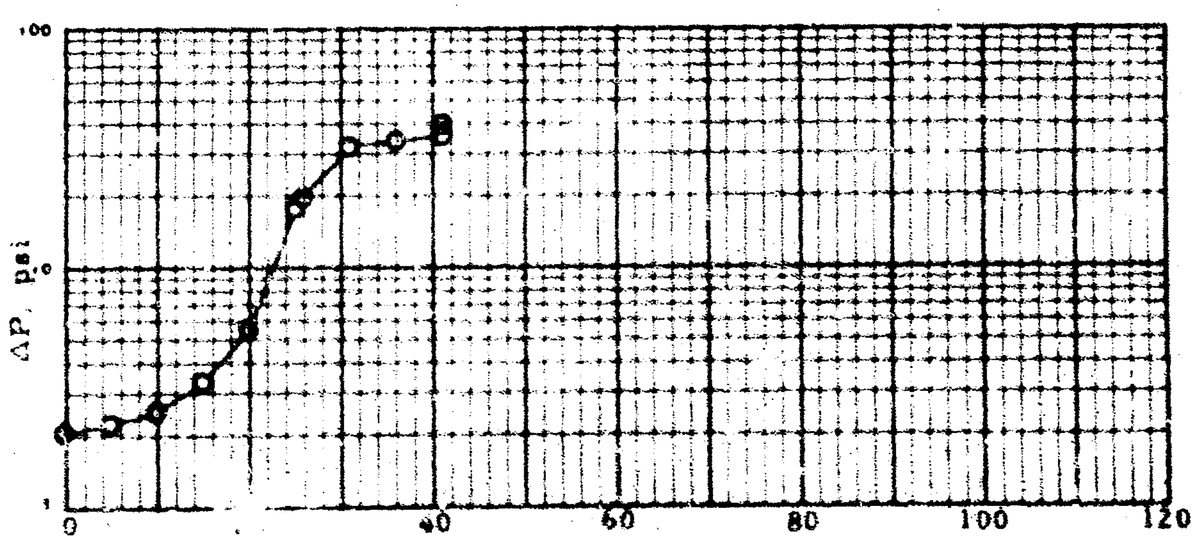


TABLE 197. SINGLE-ELEMENT LOOP TEST NO. 242 Date: 2-Oct-68

Loop no.	3(Al/SS)	Housing:	8" ID Aluminum
		Element:	Filters Inc. I 4208 Lot 465
		Canister:	DoD type 1

Procedure no.	13-A	Fuel flow, gpm	20
Water:	Filtered Tap Water	Fuel inlet temperature, °F	80
Solids:	Coarse AC Dust	Fuel inlet pressure, psi	70

Water injection schedule: 0.002 gpm from 0 min to 20 psi, then 0.2 gpm to end of test.

Solids injection schedule: 5.72 g/min from 0 min to 20 psi, then discontinue 15 min, then 5.72 g/min to end of test.

Test fuel JP-5 batch no. 23 , reused, clay-treated
Date blended with additives: 2-Oct-68
Anti-icing additive 0.15 vol. %, Dow, Lot 0226816
Corrosion inhibitor 20 lb/Mbbl, Du Pont RP-2 , Lot 333

Test duration, min	79	Calculated dirt loading, g	366
Fuel throughput, gal	1585	Actual element weight gain, g	352
Average rate, gpm	20.1		

Time	0 min	End Test
Meter reading, gal	300	1885
Screen ΔP, psi	3	3
Cleanup ΔP, psi	1	1

Analyses on influent fuel:

Time	Post Clay Filter	Pre-Test	Post Test
WSIM, distilled water	98	63	61
IFT, distilled water, dyn/cm	43.5	26.2	25.8

Analyses on injection water:

Time	Post Test
Solids, mg/liter	0.2
pH	7.3
ST, dyn/cm	72.8

TABLE 197. SINGLE-ELEMENT LOOP TEST NO. 242 (Cont'd)

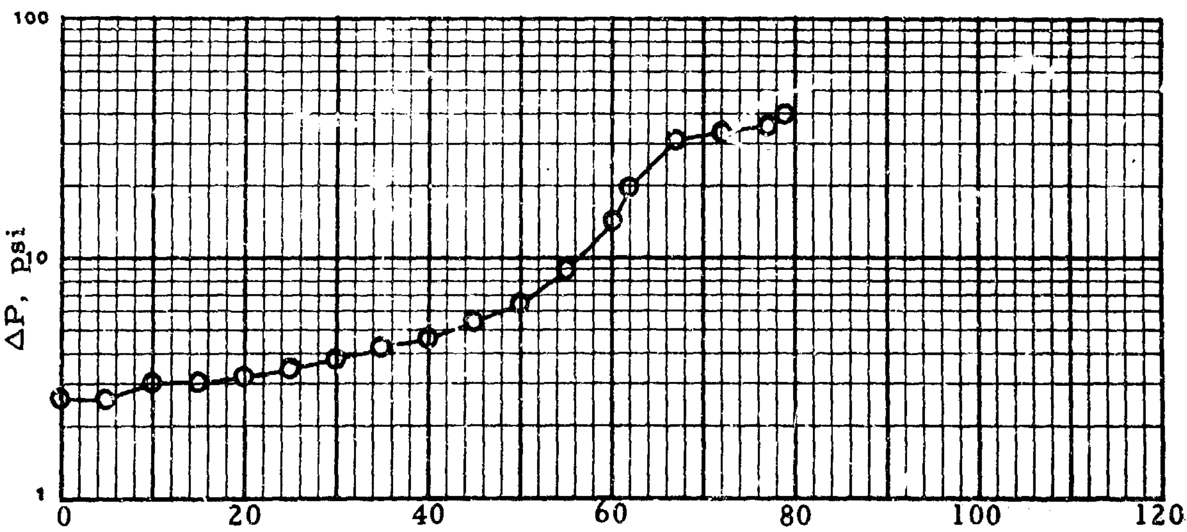
Time, min	ΔP, psi	Totamitor Infl.	Totamitor Effl.	Effluent, mg/liter Solids	Effluent, mg/liter Free water	Influent fuel temperature, °F
0	2.6	0	0			80
5	2.7	0	0	0.08	5-6	80
10	3.0	0	0			80
15	3.0	0	0			80
20	3.2	0	0			80
25	3.5	0	0			80
30	3.9	0	0			80
35	4.2	0	0			80
40	4.7	0	0			80
45	5.5	0	0			80
50	6.5	0	0			80
55	8.8	0	0			80
60	14.8	0	0			80
62	20.0	0	0[a]	0.22[b]	7-8	80
67	31.0	0	1	0.13	13-14	80
72	33.5	0	3		19-20	80
77	35.5	0	46	0.13	20+++	80
77	35.7	0	52		20+++	80
79	40.0	0	56	0.20	20+++	80

a. The initial time of the peak started at 20 psi plus 5 sec into the test and lasted for the remainder of the test. A peak value of 57 occurred at 20 psi plus 16 min.

b. AC Dust was present on the test membrane.

Schedule:

Minutes	Water, gpm	Solids, g/min
0-62	0.002	5.72
62-77	0.2	----
77-79	0.2	5.72



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13. ABSTRACT

Procedures have been developed for comparing jet fuel/inhibitor combinations in a specially designed single-element filter-separator test loop. A short-term procedure has been developed in which the schedule of contamination with solids and water is analogous to what may be encountered under field conditions. Only broad-scale classification of fuel corrosion inhibitors is possible when using either this procedure or more conventional filter-separator test procedures. Attempts to develop more severe and more discriminating procedures led to poor repeatability of results. Performance in the single-element tests could not be related to separometer (WSIM) results and several extreme examples of noncorrelation were noted both for corrosion inhibitors and fuel-soluble surfactants. Other studies in this program included the development of a small-scale coalescence rig, investigation of separometer test variability, and miscellaneous studies in the general field of fuel handling and contaminant control.

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